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ABSTRACT

The document is one of seven volumes of instructional materials developed around a cluster of Transportation Industries. Primarily technical in focus, they are designed to be used in a cluster-concept program and to integrate with a regular General Education Development (G.E.D.) program so that students may attain an employable skill level and a general academic background simultaneously. They provide basic skills necessary to enter a number of occupations in the Transportation cluster rather than an indepth development of skill in any one occupation. The volume contains approximately 120 hours of instruction in Automotive Services 1 and consists of 20 instructional units, each having one or more specific lessons. Each unit is designed for six hours, or one day, of instruction: three hours of technical laboratory instruction and three hours of related study in science, math, communications, and social studies. In most cases, there is only one lesson per unit. The units offer the instructor the essential materials: the aims (both in technical areas and in the four general education areas), instructional aids, topical outline and activities, suggested time sequence, evaluation guidelines, summary, and references. A selected bibliography concludes the volume. (Author/AJ)

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Commonwealth of Pennsylvania
Department of Justice
Bureau of Correction

VOCATIONAL EDUCATION
PROGRAM OF STUDIES

Elementary, Secondary Education Act
Title I

TRANSPORTATION CLUSTER
VOLUME I

January 1, 1971
Pennsylvania Bureau of Correction

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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Harry A. Snyder
Director of Education

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INTRODUCTION

The following information comprises one of seven volumes of instructional materials developed around a cluster of Transportation Industries and Occupations. These instructional materials are primarily technical in focus but are written to be used in a cluster concept program as part of an integrated curriculum.

The materials are aimed at preparing students with basic skills necessary to enter a number of occupations in industries within the Transportation cluster rather than providing an in-depth development of skill in any one occupation.

Each volume contains approximately one hundred twenty hours of instruction (about one month of study) and consists of twenty instructional units each having one or more specific lessons. Each unit is designed for six hours of instruction (three hours of technical laboratory experiences and three hours of related study in science, math, communications and social studies) but may be varied at the instructor's discretion.

The seven volumes or cluster areas in the series are:

- Volume I - Automotive Services I
- II - Automotive Services II
- III - Small Power Sources
- IV - Driver Training
- V - Pneumatics, Hydraulics and Fluidics
- VI - Farm and Earthmoving Equipment
- VII - Transportation Systems

Students in the Transportation cluster should be introduced to the technical and integrated content through several methods closely related to the industrial structure. Among these are line production and assembly, group projects, experimentation, unit studies and independent study. Team teaching techniques should be employed be-

tween the academic specialist and the technical specialist and coordinators.

It is recommended that an orientation program be offered students to familiarize them with the cluster areas available so they may select one they wish to pursue. The cluster instruction is designed to integrate with the regular G. E. D. program so that students may receive an employable level of skill and a general academic background simultaneously.

As students select the technical cluster area they wish to study, they should have the option to move through the G. E. D. content at their own speed using programmed instructional materials, instructional television, computer assisted instruction and other individualized learning techniques. Technical and integrated concepts are introduced each day by the specialists involved.

After completion of one or more months of work within one cluster, a student could elect to study within another cluster providing, of course, this transfer is agreeable with the counselors, coordinators and instructors involved.

Lessons have been identified in the units. In most cases, however, there is only one lesson since each unit is limited to one day or six hours of instruction. The units offer the instructor the essential materials, vis-a-vis the aims, instructional aids, topical outline and activities, suggested time sequence, evaluation guidelines, summary and references. The primary and supplemental references are directly related to the topics and are important to the instructors. A selected bibliography is attached at the end of each volume as recommended additional sources of information.

Pagination of the units in this volume has been identified by cluster (T), volume (I, II, etc.), unit (1, 2, etc.) and page (.1, .2, .3, etc.) within each unit.

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INSTRUCTOR'S UNIT PLAN

Unit 1
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Automotive Service Industry

AIM: To identify the personal background and qualifications necessary for employment within the automotive service occupations.

INSTRUCTIONAL AIDS:

Film - **Personal Qualities for Job Success**, ESC 308, Bloomington, Ind.: A-V Center, Indiana University, Division of Extension (Rental \$3.40) (11 minutes, 16mm).

EQUIPMENT:

16 mm projector and screen.

PRIMARY REFERENCES:

- 1) **Dictionary of Occupational Titles, Volume 1 . . . Definitions of Titles**, Washington, D. C.: U. S. Government Printing Office, Third Edition.
- 2) **Occupation Outlook Handbook**, Washington, D. C.: U. S. Government Printing Office.

I. INTRODUCTION and MOTIVATION

Introduce and present the film: **Personal Qualities for Job Success**. Discuss the importance of responsibility and personal qualifications for employment in the automotive service industry.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Identify the service industry job classifications.	1. Jobs commonly found in an automotive center include: a. Proprietor b. Manager c. Mechanic d. Lubrication Specialist e. Gasoline Pump Attendant f. Car Care Specialist g. Tire Specialist h. Housekeeper	
B. General nature of the work involved in the above job classifications.	1. Description of job priorities and skill . . . salary levels.	
C. Personal background and skills necessary for success in service center employment.	1. Need general skills in automechanics. Understanding of theory, operation, maintenance and service of automobiles. 2. Educational background recommended and required for employment.	
D. Demonstrate problems of communications related to service center employment.	1. Persons employed in a service center must be able to effectively transmit and receive ideas, orders, complaints, etc., from customers as well as fellow employees. a. Written Communications b. Verbal Communications 2. Employee should possess or develop good salesmanship ability.	
E. Explore the mathematical computational skills necessary for successful employment.	1. Money paid out or received must be accurately recorded and accounted for. 2. Sale of products by volume, fractional parts and discounts.	
F. General overview of scientific knowledge necessary for successful employment.	1. Need to understand and be able to handle chemicals, toxic gases and fumes, highly volatile liquids, explosive materials, etc., safely.	1. Develop basic concepts in science and physics, i. e., objects and their composition, heating and ventilation theories, chemical compositions used in automotive industry, etc.
G. Present the many opportunities for success and promotion in auto service industry.	1. Scope of automotive service industry. Needs of this industry. 2. Training opportunities for automotive service personnel.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Line and staff organization of personnel.
		1. Role relationship between management and labor personnel.
1. Determine salary levels and pay periods.	1. Common problems related to understanding and filling out employment application forms.	1. Development of concept of self image . . . as others see us.
	1. Basic written and verbal grammatical skills for communicating with customers and fellow employees. 2. Importance of good customer relations. 3. Elements of salesmanship. 4. Problems and procedures recommended for handling customer telephone conversations.	
1. Basic computational skills for pricing, computing cost, making change, and estimating monetary assets and liabilities. 2. Operation of cash register.		
1. Compare costs of basic or advanced training with increased earning power.		1. Effects of improved salary, employment level and general prestige on the individual and his family.

III. APPLICATION

- A. Involve students in role playing various service center activities with use of tape recordings and structured situations.
- B. Have students list personal qualifications in order of priority as they view them.

IV. EVALUATION CRITERIA GUIDELINE

Not applicable to orientation.

V. SUMMARY

- A. Success in the job is related to skill and academic achievement in the technical areas as well as in science, math, communications and human relations.
- B. Review important personal qualifications needed for employment in the automotive service industry.

VI. SUGGESTED TIME and SEQUENCE LISTING

Other than time required for film presentation, limitations of time should not be placed upon any given presentation which would infringe upon student motivation and student interaction.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Aspley, N. C., **The Greatest Business in the World**, Chicago: The Dartnell Corporation, 1962.
- 2) **Automotive Service Station Attendant**, Largo, Fla.: Florida State Employment Service, 1961.
- 3) **Automotive Service Station Attendant**, Tallahassee, Fla.: Florida State Employment Service, 1961.
- 4) **Employment Outlook for Gasoline Service Station Attendants**, Washington, D. C., U. S. Government Printing Office, 1964.
- 5) **Facts About Gasoline**, New York: Ethyl Corporation, Petroleum Chemicals Division.
- 6) "Gasoline Service Station Attendants," **Occupational Outlook Handbook**, Washington, D. C.: U. S. Government Printing Office.
- 7) Moulton, Richard H., **Twelve Pointers that Lead to Promotion**, Littleton, New Hampshire: Executive Development Press, Inc., 1960.
- 8) **Opportunities in Automotive Service**, Detroit: Automobile Manufacturers Association, 320 New Center Building, 1963.
- 9) **Service Station Attendant**, California State Department of Employment, 800 Capitol Avenue, Sacramento, California.
- 10) **Service Station Attendant**, The Guidance Centre, Ontario College of Education, University of Toronto, 371 Bloor Street, W. Toronto, Ontario.
- 11) **Service Station Management**, National Cash Register Company, Main and K Streets, Dayton, Ohio: 1961.
- 12) **Service Station Operation as a Career**, Institute for Research, 537 South Dearborn, Chicago: 1963.
- 13) **Service Station Salesman**, Chronicle Guidance Publications, Inc., Moravia, New York: 1962.
- 14) **Service Station Workers**, Science Research Associates, 259 E. Erie Street, Chicago, Ill.: 1964.
- 15) **Starting and Managing a Service Station**, Washington, D. C.: U. S. Government Printing Office, 1961.

INSTRUCTOR'S UNIT PLAN

Unit 2
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Automotive Service Center Organization

AIM:

To develop an understanding of the planning, business and occupational organization of an automotive service center.

INSTRUCTIONAL AIDS:

Organizational chart and floor plan of a modern service center.
Teacher-made slides, filmstrip, or 8 mm movie showing view of modern service center.

EQUIPMENT

Materials and tools to construct a model service center.
Slide - filmstrip projector and screen.

PRIMARY REFERENCES:

- 1) **American Petroleum Institute Marketing Plan**, 1271 Avenue of the Americas, New York 10020: American Petroleum Institute.
- 2) **Service Station Management**, Pelham, New York: Humble Oil and Refining Company.

I. INTRODUCTION and MOTIVATION

- A. Show series of slides, filmstrips, or movie depicting modern service center arrangements.
- B. Discuss how best to organize the class into a working group to operate a service center.
- C. Attempt to identify some of the obvious results of good planning and organization in a service center.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Designing and planning a model service center.	- Items to consider in designing and planning a model of a service center: - Adequate work stations - Parking and vehicle care - Storage for inventory - Customer conveniences - Custodial equipment - Free vehicular movement in and around test areas - Adequate lighting, ventilating, and heating (and/or air conditioning) - Adequate safety equipment - Job responsibilities - Location of facility with regard to business potential	- Study of fuels, lubricants, and flammable materials. - Scientific safety standards.
B. Architectural considerations.	- Building code, zoning, and ordinance requirements. - Exterior and interior design and appearance of building.	Scientific developments in building materials for the future.
C. Organize class into a working service center unit.	- A service center unit usually consists of: - Proprietor - Manager - Mechanic - Lubrication specialist - Pump attendant - Car care specialist - Tire specialist - Housekeeper	
D. Determine responsibilities necessary to research and construct the model.	- The model construction should involve experiences in: - Woodworking - Metalworking - Painting - Electrical work - Sign work - Artwork - Printing - Layout	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Prepare estimates of profits and losses from sales considering overhead and other direct and indirect expenses. 2. Determine percentage estimates for ordering inventory. 3. Study of advertising costs and liability. 4. Payment of local and federal income taxes, social security, workman's compensation, and other employee benefits.		1. The human factors in building design. 2. Occupations related to automotive service industry. 3. Customer oriented service. 4. Importance of a team effort in service centers. 5. Impact of private automobile on society.
1. Prepare estimate of costs for property, building construction, and initial stocking of inventory and project extent of financial investment necessary to get a service center set up and operating.	1. Architectural terms and vocabulary. Reading and interpreting community surveys and community needs studies.	1. Problems of community zoning and ordinance regulations. Effects of these rules on people and their living habits.
1. Task force organization and time allocation.		1. Growth of auto service centers in the U. S. and their contribution to society. 2. The advantages and disadvantages of technical specialization and its effects on the U. S. economy. 3. Personnel organizations in industry. 4. History of the petroleum industry. Refineries and by-products of petroleum distillation.
1. Figure cost of materials and labor for the model.	1. How to look up research related to service center design, construction, and operation. 2. Reading and interpreting technical research.	

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
E. Make blueprints of elevation and floor plans.	1. Explain procedure for sketching out basic floor plan and building location on property. 2. Draw elevation and floor plans of the model center. 3. Draw electrical and plumbing and heating layouts for model. 4. Explain use of drafting equipment and supplies.	1. Discuss composition of masonry building materials. 2. Review heating and ventilation systems and principles. 3. Review concept of alternating and direct current and electrical circuitry.
F. Construct a model service center.	1. Model building techniques and procedures. 2. Relate problems of model buildings to full-scale construction.	1. Chemical components of glues, adhesives, paints, thinners, and other liquids and for solids used by model builders.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Factors needed for estimating and computing costs of building materials. 2. Factors needed for budgeting and accounting construction costs.	1. Understands ordering and purchasing forms, contracts, and other legal documents related to construction.	1. Early forms of architectural drafting. 2. Industrial architecture in other cultures.
1. How to measure and compute scale size.	1. Examples of leadership qualities and how man has organized for task force work in literature.	1. Getting along together on the production line.

III. APPLICATION

Students will be involved in the planning and actual construction of a model automotive service center. The accuracy and sophistication of the model will depend upon the skill and knowledge levels of the class. The instructor should emphasize the importance of efficiency and convenience in design and construction.

IV. EVALUATION CRITERIA GUIDELINE

- A. What are the important elements to consider in designing an automotive service center?
- B. What is the importance of organizing a "chain of command" or line and staff structure?
- C. How does a service center organization compare with the organization used in other industries?
- D. What is the chief purpose of a modern service center?

V. SUMMARY

The efficient operation of a service center depends on the quality of the organization and the ability of the employees to satisfy the customer.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 30 minutes . . . Present information on efficient well-designed service center.
- 70 minutes . . . Design and draw plans for model service center.
- 180 minutes . . . Laboratory experience: building model of service center.
- 60 minutes . . . Discuss integration of curriculum concepts.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Harrison, C. William, **Find A Career in Auto Mechanics**, New York: G. P. Putnam's Sons, 1964.
- 2) **Industry-Organization and Employees**, National Association of Manufacturers, 1960.
- 3) Kursh, H., Franchise . . . "Easy Way to Start Your Own Business," **Mechanics Illustrated**, August, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 3
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Automotive Service Center Safety

AIM:

To identify and promote safe practices in the operation of an automotive service center. Specific attention is given to safety of facilities and property, customer and his property and the employee.

INSTRUCTIONAL AIDS:

Safety posters.

Film - **Safe Every Second**, 30 Rockefeller Plaza, New York 22: Standard Oil Company 22 minutes, 16 mm).

Filmstrip - **Vapor Capers**, Houston, Texas: Humble Oil and Refining Company (10 minutes, 35 mm).

EQUIPMENT:

16 mm projector, filmstrip projector and screen.

PRIMARY REFERENCES:

- 1) **Auto-Life Use and Maintenance Tips**, Memphis, Tenn.: Dover Corporation, Rotary Lift Division (Handout).
- 2) Glenn, Harold T., **Automechanics**, Peoria, Ill.: Charles A. Bennett Company, Inc., 1962.
- 3) **How's Your "Safety Rating" When You Work With Tools**, Kenosha, Wis.: Snap-On Tool Corporation (Booklet).
- 4) **Service Station Safety**, 1271 Avenue of the Americas, New York 10020: American Petroleum Institute, Third Edition.
- 5) Williams, W., **Accident Prevention Manual for Shop Teachers**, Chicago: American Technical Society, 1965.

I. INTRODUCTION and MOTIVATION

Introduce and show film: **Safe Every Second**. Encourage general discussion of film message. Have students contribute to a composite list of safety practices they have seen or used previously.

II. PRESENTATION of INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Care and protection of physical facilities and property of service center.	- Major items of concern are: - Care and storage of fuels, lubricants and antifreeze. - Waste disposal and housekeeping. - Care of electrical equipment. - Care and maintenance of pneumatic equipment. - Fire prevention techniques and equipment. - Island safety. - Discuss general hazards of fuel storage and, use, waste disposal, electrical and pneumatic equipment and housekeeping. - Measures of security that should be taken to protect the facility from breaking and entry. - Commonly used types of fire extinguishers and instructions for their use. - Manufacturer's warrantee and regular service of equipment.	- Properties of fuels as a liquid and as a gas. Hazards to consider in storage and use of gasoline, oils, battery acids, etc. - Conditions which cause combustion of volatile liquids. - Principles of extinguishing gasoline and electrical fires. - General principles of electrical and pneumatic systems and equipment. - How various types of fire extinguishing equipment should be handled and maintained.
B. Care and protection of customers' property.	- Successful business is dependent upon use of customers' property which must be well protected. - Concern for customer property should include: - Safe driving habits. - Safe working habits with respect to cleanliness, proper use of electrical and pneumatic equipment, use of safety protection equipment and alertness to conditions which foster accidents. - Service center liability to customers. - Recommended rules or policies for customer safety.	Differences in quality of safety-protective equipment such as in optics, guards, switches and other controls.
C. Personal protection of employees, and general public.	- Discussion of general safety rules to be observed by all employees. - Protection from burns, electrical shocks, explosions, and malfunctions or misuse of tools and equipment. - General first aid practices.	- Nature and degree of burns from chemical, electrical and natural sources. - Treatment for electrical shock.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Formulas used to estimate loss of facilities and property from fire. 2. Economics of partial loss compared to total loss by fire. 3. Cost of insurance premiums and rates for various types of coverage. Advantage of a blanket policy. 4. Cost comparisons of electrical and pneumatic equipment used in a service center.	1. Various records and forms which should be kept in case of fire. 2. How to read and understand an insurance policy. 3. Develop vocabulary levels adequate for reading safety regulations and instructions.	1. Review of research on accident rates in auto service industries. 2. Case histories of accidents in service centers and their results to the owner, customer and employees. 3. Effects of waste disposal and contamination on communities and society as a whole. (Our "Kleenix Kulture") 4. General crime rate statistics for communities and particular types of locations of service centers. 5. Local, state and federal regulations concerning storage of volatile materials and other safety standards. 6. Underwriter's regulations concerning storage and safety standards.
1. Cost of extended customer services. 2. Cost of customer liability insurance. 3. Cost of court and legal council if involved in suit or other legal action.	1. Build confidence in the customer that you can provide him with the quality of service he requests. 2. Effects of extended customer service such as pickup and delivery of vehicles. 3. Sources of insurance for service center operation and coverage. 4. Responsibility for understanding customers who may be foreign, such as tourists from another country.	1. Responsibility of service centers to the customer and general public. 2. Discuss value of quality work versus quantity work by employees, especially in terms of efficiency in customer service. 3. Review nature of previous customers' claims and complaints. 4. Procedures normally followed in court in cases of legal action.
1. Employee compensation insurance. 2. Cost of "lost time" accidents.	1. Development of reasonable list of safety rules and procedures to be observed in a service center. 2. Read and understand instructional labels on medicine and first aid materials.	1. Percentage of accidents recorded and their effects on various degrees of lost time to the employer. 2. Workmen's compensation schemes. 3. Legal limits for administering first aid.

III. APPLICATION

- A. Have each student inspect a service center facility and assess the safe and unsafe conditions.
- B. Have students check and demonstrate correct procedures for operation of: jacks, creepers, guiders, tire tools, pneumatic lifts and tools, electrical equipment and other items which may be hazardous to operate.
- C. Have students gain experience with the use of fire extinguishers.

IV. EVALUATION CRITERIA GUIDELINE

- A. What is the definition of an accident?
- B. What are the classes of fire?
- C. How are fires distinguished?
- D. How do you treat an acid burn? An electrical shock?
- E. Relate auto service center hazards to home hazards.
- F. What legal responsibilities does a service center owner have to the facility, customer and his property and to the employee?

V. SUMMARY

- A. The nature of the products handled and the variety of the jobs make the service center an extremely hazardous place to work unless a good safety program is established and maintained.
- B. Summarize the chief elements recommended for a good safety program.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 60 minutes . . . Introduction and showing of film and filmstrip:
Safe Every Second, Vapor Capers
- 180 minutes . . . Laboratory experience
- 100 minutes . . . Integrated curriculum concepts
- 20 minutes . . . Summary and evaluation

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **Action for Safety**, XIV, No. 9, Washington, D. C.: National Commission on Safety Education, 1961.
- 2) Cole, W. and Preston, C., **First Aid . . . Diagnosis and Management**, New York: Appleton, Century, and Crofts, 1962.
- 3) **Color Dynamics**, Pittsburgh: Pittsburgh Plate Glass Company, no date.
- 4) **Energy in Color**, Pittsburgh: Pittsburgh Plate Glass Company, no date.
- 5) "Fact Sheets on Portable Fire Extinguishers," **National Safety News**, XCII (July, 1965).
- 6) **Fire Prevention Handbook**, 12th Ed., Boston: National Fire Protection Association, 1965.
- 7) **Master Maintenance** (Service Guide), Chicago: The Chek-Chart Corporation, 1968.
- 8) "Occupational Safety," **School Life**, XLI (May, 1959).
- 9) Pendered, N., "Developing Safety Consciousness", **Accident Prevention Manual for Shop Teachers**, ed. William A. Williams, National Association of Industrial Teacher Educators, Chicago: American Technical Society, 1963.
- 10) **Safety Color Code for Marking Physical Hazards and the Identification of Certain Equipment**, New York: American Standards Association of the National Safety Council, 1953.
- 11) **Safety Education Data Sheets**, Chicago: National Safety Council.
- 12) **Supervisors Safety Manual**, Chicago: National Safety Council, 2nd Edition, 1961.
- 13) **When the Unexpected Happens**, Boston: John Hancock Mutual Life Insurance Company, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 4
Lesson 1
Time 6 hours

CLUSTER: Automotive Service Tool and Equipment Identification

DIVISION: AUTOMOTIVE SERVICES I

SUBJECT: Automotive Service Tool and Equipment Identification

AIM: The purpose of this unit is to develop an understanding of the nature and variety of tools and equipment used in the automotive center and to develop explicit competency in the identification and use of these tools.

INSTRUCTIONAL AIDS:

Tool catalogs from Snap-On, Sun, Marquette, Sears and other tool suppliers.

Film - **ABC of Hand Tools** (Parts 1 and 2), Detroit: General Motors Corporation (33 minutes, 16 mm, color).

Wall charts of: Boxsocket, punch and chisel, screwdrivers and sockets, Kenosha, Wisc.: Snap-On Tool Corporation.

EQUIPMENT:

16 mm film projector and screen.

Samples of tools found in an automotive service center.

Demonstration auto engine (should be operable).

PRIMARY REFERENCES:

- 1) **ABC of Hand Tools**, Detroit: General Motors Corporation.
- 2) Allen, Willard A., **Know Your Car**, Chicago: American Technical Society, 1967, Second Edition.
- 3) Crouse, William H., **Automotive Mechanics**, New York: McGraw-Hill Book Company, Inc., 1965, Fifth Edition.
- 4) **General Repair Tools**, Albany, New York: Delmar Publishers.
- 5) Stockel, Martin W., **Auto Mechanics Fundamentals**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1968.

I. INTRODUCTION and MOTIVATION

Introduce and show film: **ABC of Hand Tools**. Discuss the various types of tools and their uses. Have students identify hand tools into families or groups. Also identify the portable power (electrical or pneumatic) tools that are used in a service center.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Importance of tools to the service center employee.	1. Technical evolution of tools down through the ages.	
B. Tool and equipment classification and identification.	1. Major groups of tools used in a service center are: a. Measuring tools b. Cutting tools c. Striking tools d. Drilling and threading tools e. Soldering and light welding tools f. Wrenches and assembling tools g. Electric and pneumatic powered tools h. Specialized and miscellaneous tools i. Electronic test equipment j. Special tools for imported cars	1. Review basic principles upon which tools work, i.e., lever, wedge, screw, inclined plane, etc. 2. Review concept of compound leverage.
C. Proper tool and equipment selection and purchase.	1. Select tools and equipment of good quality for longer life and better service. 2. Purchase tools and equipment from reliable firms which will provide satisfactory service and maintenance when needed.	1. Strength of materials used in tools. 2. Prorating costs of tools and equipment over many jobs.
D. Proper use of tools and equipment.	1. Demonstrate proper use of basic hand tools on an engine. Avoid slippage and excessive force. 2. Selecting the right tool for the job.	
E. Care and Maintenance of tools and equipment.	1. Tool storage and coding. 2. Periodical care and maintenance. 3. Rebuilding and replacement of parts. 4. Importance of returning tools to storage after a job to avoid loss and unnecessary damage.	1. Rust and corrosion preventative chemicals that can be used on tools.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Impact of tools on the economy of the U. S.	1. Read stories or articles about men who have invented tools. Trace specific development of tool families through the ages at a museum. 2. Assist students in writing complete tool specifications for ordering and purchasing.	1. General history of tools and their impact on society. 2. Show how tools have shaped the economy of the U. S. and other nations.
	1. Develop tool vocabulary to facilitate reading and understanding catalog statements.	1. Procedures of industrial purchase of tools and equipment by direct purchase, by securing bids or other procedures.
1. Compare cost with quality of tools. Set up test conditions and determine strength of materials or length of tool life.	1. Procedures for verbal and written communications between service center and tool manufacturer or supplier.	1. Function of the medieval craftsmen's guilds and apprentice programs.
	1. How to read instructions for operating power tools and special tools.	
1. Comparative costs of repairing or replacing selected tools. 2. Figuring depreciation on tools and equipment. 3. The problem of passing along extra costs to the consumer.	1. Discuss research on storage of tools, i. e., open storage or closed storage, individual employee tool kits, central tool storage, etc. 2. Read and understand vocabulary in the two booklets: The Amazing Story of Measurement and ABC of Hand Tools .	1. The effects of improved tool design and portability. 2. Effects of expanding technology on society.

III. APPLICATION

- A. Have students demonstrate proper use of tools by removing and replacing parts on an auto engine.
- B. Display variety of tools from different manufacturers and have students select the better quality tools and explain why they are better quality.
- C. Students should be able to search through tool catalogs and prepare accurate specification sheets which would enable them to purchase the tools. A specified list of tools may be assigned to each student by the instructor.
- D. Students may need time to finish the service center model started in Unit 3.

IV. EVALUATION CRITERIA GUIDELINE

- A. Why is it important to use the correct tool for each job?
- B. What constitutes quality tools?
- C. How are tools identified and classified
- D. What are some of the techniques commonly used in tool storage and service?
- E. Why is it important to return tools to their storage place after each job?
- F. Should customers be allowed to borrow service center tools?

V. SUMMARY

Most servicing on automotive vehicles is done with hand tools and the improper use of them destroys both the tool and the success of the job. It is therefore important that employees use the correct tools; use quality tools; care for and maintain tools; and most of all, return tools to their proper storage place when finished with each job.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 45 minutes . . . Introduce and show film: **ABC of Hand Tools.**
- 180 minutes . . . Laboratory experience . . . use of tools.
- 115 minutes . . . Integrated curriculum concepts.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Adler, Irving, **Tools in Your Life**, New York: The John Day Company, 1956.
- 2) Beeler, Samuel C., **Understanding Your Car**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1967.
- 3) Burns, William A., **Man and His Tools**, New York: McGraw-Hill Book Company, Inc., 1956.
- 4) Liberty, Gene, **The First Book of Tools**, New York: Franklin Watts, Inc., 1960.

INSTRUCTOR'S UNIT PLAN

Unit 5
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION

DIVISION: AUTOMOTIVE SERVICES I

SUBJECT: Service Center Skills (Technical)

AIM: To provide a general overview of the technical skills required for service center employment.

INSTRUCTIONAL AIDS:

Sample credit cards and credit card imprinter.

Film - **Say It With Service**, A. P. Parts Corporation, 1963 (15 minutes, 16 mm, black and white).

Film - **Servicing the Radiator Pressure Cap** (8 mm loop).

Film - **Battery Service, Auto Maintenance Series**, 12121 Avenue of the Americas, New York 10036: Modern Learning Aids (8 mm loop).

EQUIPMENT:

16 mm projector, 8 mm single loop projector and screen.

PRIMARY REFERENCES:

- 1) **Motor's Flat Rate Manual**, 41st Ed., New York: Motor Publishing Company, 1969.
- 2) **Service Station Management**, New York: Humble Oil and Refining Co.
- 3) Stockel, Martin W., **Auto Mechanics Fundamentals**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1968.

I. INTRODUCTION and MOTIVATION

- A. Introduce and show the film: **Say It With Service**. Follow with discussion of service expected of service centers.
- B. Identify some of the necessary skills employees need to do satisfactory work in a center.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTION TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Discuss the correct procedures for the following services: (Instructor should demonstrate each of these service operations as time permits).		
A. ¹ Battery	1. Clean, check and add water to battery. 2. Load test battery. 3. Show film on battery service.	1. Purpose of distilled water in battery. 2. Battery charge and discharge theory.
A. ² Radiator	1. Check and add water to radiator. 2. Remove, flush and replace antifreeze in radiator. 3. Remove and replace thermostat. 4. Replace radiator and heater hoses. 5. Check, adjust or replace fan belt. 6. Show film on servicing radiator pressure cap.	1. Purpose of antifreeze solution in radiator. 2. Rust inhibitors and preventatives.
A. ³ Engine	1. Check and add oil to engine. 2. Clean engine with steam or chemicals. 3. Change engine oil and filters. 4. Check and replace emission control devices. 5. General inspection for engine oil leaks around gaskets.	1. Viscosities of oils and greases. 2. Multiweight oils vs. single weight oils. 3. Meaning of high detergent and other oil additives.
A. ⁴ Tires	1. Check and properly inflate tires. 2. Remove, repair and replace tires. 3. Wheel balancing.	
A. ⁵ Chassis	1. Lubricate vehicle. 2. Check and add proper oils and lubricants to transmission, differential, power steering, brakes and other hydraulically operated equipment.	1. Explain various types of lubricants available for auto service.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Economic advantages of keeping a vehicle in good condition.		
	1. Be able to read test devices, gauges, meters and other instruments. 2. Strategies to use in talking with customers when they specify a particular type of product or service that is known to be faulty and costly to them in the near future.	1. Attitudes of people toward service center employees.
1. Compare cost of using alcohol with cost of permanent type anti-freeze.		
1. Understand measures of volume, weights and pressures.	1. How to read an automotive specification sheet.	1. Problem of convincing people to keep their vehicles tuned and serviced regularly. 2. Concept of "package replacements" in auto service. 3. Problem of "engineered obsolescence" in modern vehicles.
1. Techniques to extend life of tires such as rotation, driving habits and care in acceleration.	1. Learn how to read customer's service manual and special booklet.	1. Problem of inconsistency of quality in tire manufacturing. 2. Government regulations on tire manufacturing.
1. Determine cost of chassis lube based on cost of various lubricants and oils used. 2. Pricing theories. 3. Determining job costs by using flat rate manual.	1. Methods of informing customers of new products available in auto service. 2. Advertising and sales strategies. 3. Read and follow directions on lube service chart.	1. Study ways and means of influencing public opinion. 2. Effects of motivation research on the general public.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A ⁶ Ignition	1. Check and reset ignition points. 2. Remove and clean spark plugs. 3. Set timing.	1. Concept of ignition timing.
A ⁷ Carburetion	1. Adjust carburetor valves. 2. Check fuel pump. 3. Clean or replace air filter.	1. Principle of venturi and gas-air mixture process.
A ⁸ Heating and Air Conditioning	1. Inspect heater and air conditioning hoses and tubing. 2. Check compressor belt.	1. Basic theory of refrigeration and air conditioning.
A ⁹ General inspection (Body)	1. Clean windshield and outer glass area. Check glass for damage. 2. Check and replace windshield wiper blades. 3. Check and replace light bulbs, reflector plates and fuses.	
A ¹⁰ Miscellaneous	1. Wash and wax car body. 2. Clean and vacuum interior. 3. Check and clean out window washer hoses.	1. Compare one step waxes and polishes with conventional two step process.
B. Road service	1. Pushing and towing. 2. Starting. 3. Diagnosing and trouble-shooting engine trouble.	1. Caster effect and its importance in towing a car. 2. Proper battery jumper cable hookup to avoid damage to electrical system.
C. Salesmanship and promotion of products and services.	1. Techniques of selling new and rebuilt components. 2. Methods of price adjustments on faulty or warranted products. 3. Local sales promotional programs.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Figure ignition dwell angle and point gap size.		1. Development of the Kettering type ignition from the original magneto coil system.
1. Determine combustion efficiency.		
		1. Discuss effects of air conditioning in cars with regard to health, alertness, comfort and safety.
		1. Necessity of state auto inspection requirements.
	1. How to locate place of emergency on road map. 2. Answer and respond to emergency calls.	1. Compare relative value of objects that are kept clean and well preserved to those that deteriorate naturally. 2. Road service insurance and service to travelers.
1. Figure volume sales against standard sales procedures.	1. Make sales and promotional signs and displays. 2. Read Vance Packard's <i>Hidden Persuaders</i> .	1. The potential of an advertising-minded public. Psychology of buying and selling.

III. APPLICATION

A. Divide students into groups of two or three and have them perform some of the services identified in this unit until a satisfactory level of competence is met.

B. Have students become familiar with the lube charts and other instructional information which they will need to use for reference quite often.

IV. EVALUATION CRITERIA GUIDELINE

A. Which skills must you acquire in order to satisfy most customer requests?

B. Which services seem to require greater skills and need the most practice?

C. What is meant by preventive maintenance?

D. Observe student practices and performance in diagnosing and troubleshooting problems.

V. SUMMARY

Most skills required of the service center employee are not too difficult to master but must be accomplished with extreme care because of their importance to the customer. The center employee may be generally conceived as a jack-of-all-trades.

VI. SUGGESTED TIME and SEQUENCE LISTING

30 minutes . . . Show and discuss film: **Say It With Service.**

20 minutes . . . Introduction and showing of films: **Servicing the Radiator Pressure Cap and Battery Service.**

210 minutes . . . Laboratory experience and practice.

60 minutes . . . Integrated curriculum concepts.

40 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Beeler, Samuel C., **Understanding Your Car**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1967.

2) Harrison, C. William, **Find A Career In Auto Mechanics**, New York: G. P. Putman's Sons, 1964.

3) **Shellubrication Specification Guide Book**, Shell Oil Company, 1969.

4) Toboldt, William K., **Auto Body Repainting**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

5) **Tune-Up Manual 1959-1967**, Volume 1, Berkeley, Calif.: National Automotive Service Company, 1967.

6) Wetzel, G., **Automotive Diagnosis and Tune-Up**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1965.

INSTRUCTOR'S UNIT PLAN

Unit 6
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Radiators and Cooling System Service

AIM: To develop an understanding of the processes of heat exchange within cooling systems and proper servicing procedures for various types of systems.

INSTRUCTIONAL AIDS:

Film - **Automobile Cooling System**, 30 East 42nd Street, New York, New York: National Carbon Company (10 minutes, 16 mm) (free on loan).

Film - **Temperatures Made to Order**, Detroit, Mich. 48202: General Motors Film Library, General Motors Building (24 minutes, 16 mm).

Transparencies: **Radiator (AM-11), Water Pumps (AM-12), Engine Temperatures (AM-34)**, 4560 East 71st Street, Cleveland, Ohio 44105: Brodhead-Garrett Company.

Filmstrip - **Engine Temperature Control**, Lockport, New York: Harrison Radiator Division, General Motors Corporation (40 minutes, 35 mm).

Filmstrip - **The Engine Cooling System in the Modern Automobile, The Engine Cooling System . . . Winter Operation, The Engine Cooling System . . . Basic Maintenance**, 30 East 42nd Street, New York: National Carbon Company (35 mm, sound, color).

Filmstrip - **Introduction to the Cooling System**, 1445 Park Avenue, New York: United World Films, Inc. (#OE464S).

Charts - **Cooling System Wall Chart**, #5807A, Wilmington, Del.: E. I. duPont de Nemours & Co., Inc., **Automobile Engine Cooling System Wall Chart**, AFP-1511, 30 East 42nd Street, New York: National Carbon Company.

EQUIPMENT:

Overhead projector, 16 mm projector, 35 mm filmstrip projector and screen. Cross-sections of down-flow and cross-flow radiators, radiator pressure caps, pressure cap testers, water pumps and water hoses (new and oxidized).

PRIMARY REFERENCES:

- 1) Crouse, William H., **Automotive Fuel, Lubricating and Cooling Systems**. New York: McGraw-Hill Book Company, Inc., 1959.
- 2) Glenn, Harold T., **Automechanics**, Peoria, Ill.: Charles A. Bennett Company, Inc., 1962.
- 3) **Serviceman's Manual on the Automotive Cooling System**. The Wilmington, Del.: E. I. du Pont de Nemours & Company, Inc., 1951.
- 4) Stockel, Martin W., **Auto Mechanics Fundamentals**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 5) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**. Chicago: American Technical Society, 1967, Third Edition.
- 6) **What Every Service Man Should Know About Automobile Cooling Systems**, 30 East 42nd Street, New York: National Carbon Company, 1954.

1. INTRODUCTION and MOTIVATION

- A. Introduce lesson with the film: **Automotive Cooling System**. Elicit student responses.
- B. Assign specific questions for students to locate in film **Temperatures Made to Order**.
- C. Have demonstrations of safe removal of pressure caps from radiators under pressure.
- D. Show class examples of radiator and cooling system service.

II. PRESENTATION of INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Two basic cooling systems used on cars are: 1. Air cooling 2. Liquid cooling	1. Basic principles of operation of the two systems. 2. Heat is exchanged by three methods: a. By conduction through solids. b. By convection through liquids and gases. c. By radiation through space. 3. Trace flow pattern through liquid and air cooling system. 4. Gasoline heaters used in air cooled cars.	1. Theory of heat transfer by conduction, convection and radiation. 2. Operation of thermostat in liquid cooled system. 3. Variations of heat dissipations in air and liquid cooled engines. 4. Types of antifreezes used in radiators.
B. Basic components of liquid cooling systems.	1. Water jackets, water pump, fan and fan belt, radiator, hoses and hose clamps, thermostats, pressure type radiator cap and expansion tank. 2. Location of radiator and engine block drain petcocks and expansion plugs.	1. Review pulley and belt theories. 2. Composition of hoses, radiator tubes and fan belts. 3. How the pressure type radiator cap works. Safe pressure ranges. 4. Radiator additives. 5. Heat conducting metals. 6. Effects of air pockets in a cooling system.
C. Basic components of air cooling systems.	1. Cooling fins, fan and thermostat.	1. Operation of thermostat in air cooled system. 2. Dissipation of heat through cylinder fins.
D. Common services required on radiators and cooling systems in general.	1. List of services a center should provide: a. Check system for leaks. b. Replace radiator hoses and clamps. c. Flush radiator and engine. d. Check liquid level in radiator and add water, antifreeze, or other additive. e. Replace water pump and gaskets. f. Replace fan. g. Remove and test thermostat. h. Replace thermostat. i. Replace fan belt. j. Test radiator pressure cap. k. Test antifreeze solution in radiator. l. Remove and repair radiator, clean foreign objects from cracks and crevices. m. Repair or replace heater core. n. Diagnosing and trouble-shooting cooling system problems.	1. Types of radiator cleaners. 2. Effects of excessive water pressure when flushing a liquid cooling system. 3. Air displacement of three-bladed and four-bladed fans. 4. Bimetal switch operation. 5. Principles of brazing and soldering on light metals. 6. Safety hazards in handling anti-freeze and other cooling system products.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Engineering characteristics of air cooled engines. 2. Determine volume and capacity of liquid systems. 3. Need to maintain stable engine operation and temperature for best efficiency.	1. Use of liquid cooling for passenger comfort. 2. Read and understand instrument panel lights and gauges.	1. Consumer influence on automotive design and engineering. 2. Development of the cooling system in automobiles. 3. Cooling systems used on racing cars.
1. Figure fan belt and hose lengths, inside and outside measurements and hose shapes. 2. Capacity measurement of radiator. 3. Mixture ratio of water to anti-freeze. 4. Radiator pressure readings. 5. Effects of fan on engine efficiency. 6. Expansion coefficients of liquid coolants.	1. Understand diagrams of cooling systems.	1. Greater ability of automobile to operate in high altitudes because of pressurized cooling system.
1. Expansion and contraction of air cooled engines and operational tolerances.	1. Read and understand cooling system vocabulary.	1. Discuss why engines are often placed in rear of cars rather than front.
1. Determine correct size, shape, ingredients, etc., for replacement parts. 2. Schedule customer service on reasonable time basis allowing sufficient time to complete a job. 3. Soldering temperatures and heat control when servicing radiator. 4. Cost of radiator repair compared to cost of replacement.	1. Determine appropriate identification numbers or other schemes for labeling parts. 2. How to read and interpret maintenance charts on cooling systems. 3. Communicate results of trouble-shooting the system to the customer. Advise customer on course of action. 4. Read trouble-shooting equipment meters and charts. 5. Be able to explain results of diagnosis to customer clearly.	1. Manufacture and sales of cooling system parts and products. 2. Effects of radiator design and location on driver's vision and safety.

III. APPLICATION

- A. Utilize films, filmstrips and transparencies to present information.
- B. Students will examine and test thermostats, remove and replace water hoses, charge cooling systems with proper coolants and clean air passages of radiators to demonstrate their ability to perform these services.

IV. EVALUATION CRITERIA GUIDELINE

- A. Give six reasons why an engine must not run too cool or too warm.
- B. What are the three jobs that a cooling system must perform?
- C. What is the purpose of the thermostat?
- D. Why are cooling systems pressurized?
- E. Why are radiators painted black?
- F. Observe student skills.

V. SUMMARY

All internal combustion engines must be cooled either by air or by a liquid; the liquid commonly used being water. The coolant, be it air or liquid, must surround all the areas subjected to heat from the burning fuel charge. The coolant transfers the internal engine heat to the surrounding air by a combination of conduction, convection and radiation.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 40 minutes . . . Introduction and showing of films: **Automobile Cooling System and Temperatures Made to Order.**
- 180 minutes . . . Laboratory experience working with cooling systems.
- 60 minutes . . . Utilization of filmstrips and transparencies.
- 60 minutes . . . Integrated curriculum concepts.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **Automotive Cooling and Heating Systems Manual** Lockport, New York: Harrison Radiator Division of General Motors Corporation.
- 2) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part One . . . The Engine**, Milwaukee: Bruce Publishing Company, 1964.
- 3) **Harrison Heat Exchangers**, Lockport, New York: Harrison Radiator Division of General Motors Corporation.
- 4) **Master Maintenance** (Service Guide), Chicago: The Chek-Chart Corporation, 1968.
- 5) **Motor's Auto Repair Manual** 32nd Ed., New York: Motor Publishing Company, 1969.
- 6) Murphy, P., **Chilton's Automotive Repair Manual**, Philadelphia: Chilton Company, 1969.
- 7) **Shelllubrication Specification Guide Book**, Shell Oil Company, 1969.
- 8) **Water Story . . . The Hydrologic Cycle**, The, Detroit: General Motors Corporation.

INSTRUCTOR'S UNIT PLAN

Unit 7
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Battery and Battery Service
AIM: To develop an understanding of the correct and safe procedure of charging, installing and servicing automotive batteries.

INSTRUCTIONAL AIDS:

Film - **The Story of the Modern Storage Battery**, 2800 Forbes Avenue, Pittsburgh: Bureau of Mines (27 minutes, 16 mm, sound).

Chart - **The Automotive Storage Battery and Electrical Systems X-0157**, 246-286 East 131st Street, P. O. Box 6266, Cleveland: Exide Automotive Division, Electric Storage Battery Company (Wall Charts).

Chart - **Fundamentals of Electricity and Magnetism, Section A, Storage Batteries, Section B**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (Wall Charts).

Handout - **Introduction to Automotive Electrical Systems (DR-9010)**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation.

EQUIPMENT:

Cutaway battery, hydrometer, sulphuric acid, battery test equipment and special tools.

PRIMARY REFERENCES:

- 1) Allen, Willard A., **Know Your Car**, Chicago: American Technical Society, 1967, Second Edition.
- 2) Crouse, William H., **Automotive Electrical Equipment**, New York: McGraw-Hill Book Company, Inc., 1966, Sixth Edition.
- 3) Crouse, William H., **Automotive Mechanics**, New York: McGraw-Hill Book Company, Inc., 1965, Fifth Edition.
- 4) Kuns, Ray F. (Rev. by Duvall, Jack J.), **Automotive Essentials**, Milwaukee: Bruce Publishing Company, 1966.
- 5) Stockel, Martin W., **Auto Mechanics Fundamentals**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 6) **Storage Batteries**, Anderson, Ind.: Delco-Remy Division of General Motors Corporation.
- 7) **Storage Battery, Its Fundamentals, Use and Maintenance**, The 246-286 East 131st Street, P. O. Box 6266, Cleveland, Ohio: Exide Automotive Division, Electric Storage Battery Company.
- 8) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**, Chicago: American Technical Society, 1967, Third Edition.

I. INTRODUCTION and MOTIVATION

A. Introduce the film: **The Story of the Modern Storage Battery**. Identify specific points for the students to look for.

B. With wall charts as supplemental aids, use a cutaway storage battery to acquaint students with its construction.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Battery construction and operation.	1. Materials and techniques used in battery construction. a. Case b. Positive plates c. Negative plates d. Electrolyte solution e. Separators f. Terminals 2. Importance of battery to car operation. 3. Conversion of chemical energy to electrical energy in the battery. 4. Characteristics of discharged and charged batteries. 5. Quality construction vs. economy construction. 6. Three major functions of the storage battery.	1. Selection of materials for battery construction. 2. How electrical energy is generated from electrolysis. 3. Chemical composition of electrolyte. 4. What happens when a battery discharges; when it charges? 5. Causes of battery shorting and dead cells. 6. Hazards of toxic gases formed during battery charge.
B. Servicing a storage battery.	1. Check and add water to cells. 2. Clean and tighten cable clamps. 3. Voltage and amperage test. 4. Hydrometer test. 5. Load test. 6. Replace cables. 7. Charge a battery a. Slow charge b. Fast charge 8. Battery removal and installation. Dry charging a new battery. 9. Clean corrosion from terminals and battery holder, and apply grease as preventative. 10. Battery storage. 11. Troubleshooting techniques.	1. Concept of specific gravity. What causes water to be lost during charging and discharging. 2. Add water to cells, not acid. 3. Proper connection of test equipment leads to terminals on battery. 4. Reversal of discharge process. 5. Danger of overcharging battery. 6. Forms of battery corrosion and preventative materials. 7. Flexibility of the voltmeter for troubleshooting electrical circuits.
C. Safety procedures to be followed in servicing storage batteries.	1. Be familiar with safety rules and procedures for serving batteries. 2. First aid procedures for persons who have been burned by battery acid.	1. Understand the hazards of battery electrolyte and its potential danger to the skin and clothes.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. How to determine battery voltage and amperage. 2. Frequency of use may be inversely related to battery life.	1. Identification and rating schemes for batteries.	1. Develop appreciation for function of battery as heart of automotive systems. 2. The problems of hand cranking older cars. 3. Inherent dangers in battery electrolyte solution and gases formed during battery charging and discharging.
1. Determine specific gravity level. 2. Use of Ohm's law. 3. Understand volts and amperes. 4. Selection of right battery for your car. a. Economy, original equipment or heavy duty b. 6 volt or 12 volt	1. Color schemes for identifying positive and negative terminals. 2. Familiarization with literature on batteries. 3. Oral communication skills needed for service and sales of batteries. 4. Discuss importance of diagnostic skills and troubleshooting procedures. 5. Be able to explain terms of battery guarantee and price adjustment to customer.	1. Compare quality and durability of "dry" battery with "wet" battery. 2. Discuss concept of guarantee and warrantee, implied and expressed. 3. General customer expectations of quality in "original" equipment. 4. Price adjustments and their effects on consumer buying habits. 5. Approaches to selling auto batteries.
		1. Research on improving battery design and construction.

III. APPLICATION

Students should gain laboratory experience in:

- 1) Battery installation in automobiles.
- 2) Battery charging and testing.
- 3) Troubleshooting procedures.

IV. EVALUATION CRITERIA GUIDELINE

- A. Describe briefly the construction of a typical automotive battery.
- B. What are some safety precautions to follow in servicing and installing batteries?
- C. How is a battery charged?
- D. What are the three major functions of the storage battery?

V. SUMMARY

The battery is the most important electrical component of the automobile . . . it stores the electrical power needed by the automobile. The storage battery, although not too complex, must be handled with care because of the highly corrosive acid it contains. It is most important that safe practices be used when servicing batteries.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 40 minutes . . . Introduce and review film: **The Story of the Modern Storage Battery.**
- 150 minutes . . . Laboratory experience working with batteries.
- 40 minutes . . . Science concepts: chemistry of lead acid batteries, electron theory, specific gravity.
- 30 minutes . . . Math concepts: hydrometer reading conversion, determining voltage and amperage, price adjustments.
- 80 minutes . . . Social studies and communications concepts: impact of storage battery on society, reading on battery installation, troubleshooting, charging and servicing.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIALS

- 1) Corbett, Scott, **What Makes A Car Go**, Boston: Little, Brown & Company, 1963.
- 2) **Delco-Remy Test Specifications** (DR - 324S, DR - 324S-1, DR - 324S-2), Anderson, Ind.: Delco-Remy Division of General Motors Corporation.
- 3) **Delco-Remy Training Chart** (Sections A and B), Anderson, Ind.: Delco-Remy Division of General Motors Corporation.
- 4) **It's Easy To Be An Expert . . . Battery Man, That Is**, Anderson, Ind.: Delco-Remy Division of General Motors Corporation.

INSTRUCTOR'S UNIT PLAN

Unit 8
Lesson 1, 2, 3, 4
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES
SUBJECT: Electrical Systems Service

AIM: To develop skill and understanding of servicing the various electrical systems of the automobile.

INSTRUCTIONAL AIDS:

Film - **The Spark of Power**, 3 East 54th Street, New York: Champion Spark Plug Company, Modern Talking Picture Service (14 minutes, 16 mm, sound).

Film - **The Spark Plug Story**, Flint, Mich.: AC Spark Plug Division, General Motors Corporation (37 minutes, 16 mm, sound, color).

Film - **How to Service Spark Plugs**, Flint, Mich.: AC Spark Plug Division, General Motors Corporation (15 minutes, 16 mm, sound, color).

Filmstrip - **Introduction to Automotive Electricity**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (15 minutes, 35 mm, sound, color).

Filmstrip - **The Cranking Circuit**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (12 minutes, 35 mm, sound, color).

Filmstrip - **20,000 Volts Under the Hood**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (12 minutes, 35 mm, sound, color).

Filmstrip - **Better Ignition**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (20 minutes, 35 mm, sound, color).

Filmstrip - **Regulation and the Charging Circuit**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (20 minutes, 35 mm, sound, color).

Filmstrip - **Standard-Duty Generator Regulators**, Anderson, Ind.: Delco-Remy Division, General Motors Corporation (20 minutes, 35 mm, sound, color).

Transparencies - **Starting System #636, Charging System #637, Spark and Ignition #638, Ignition System #639**, 2501 Hudson Road, St. Paul, Minn.: Minnesota Mining and Manufacturing Business Products.

Transparencies - **Spark Plugs AM-9, Ignition Distributor AM-28, Ignition Coil and Condenser AM-29**, 4560 East 71st Street, Cleveland, Ohio 44105: Brodhead-Garrett.

EQUIPMENT:

Overhead projector, 16 mm film projector, screen and filmstrip projector.
Mock-up displays and prototypes of electrical systems.
Ignition simulator.

PRIMARY REFERENCES:

- 1) Allen, Willard A., **Know Your Car**, Chicago: American Technical Society, 1967, Second Edition.
- 2) Crouse, William H., **Automotive Electrical Equipment**, New York: McGraw-Hill Book Company, Inc., 1966, Sixth Edition.
- 3) Crouse, William H., **Automotive Mechanics**, New York: McGraw-Hill Book Company, Inc., 1965, Fifth Edition.
- 4) Frazee, I. and Bedell, E., **Automotive Electrical Systems**, Chicago: American Technical Society, 1967.
- 5) Glenn, Harold T., **Automechanics**, Peoria, Ill.: Charles A. Bennett Company, Inc., 1962.
- 6) Kuns, Ray F. (Rev. by Duvall, Jack J.), **Automotive Essentials**, Milwaukee: Bruce Publishing Company, 1966.
- 7) Stockel, Martin W., **Auto Mechanics Fundamentals**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 8) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**, Chicago: American Technical Society, 1967, Third Edition.

I. INTRODUCTION and MOTIVATION

A. Present an illustrated lecture-demonstration of:

- 1) **The Spark of Power**, a film; point out specific points to be remembered.
- 2) Show transparencies of various electrical systems pointing out the systems and their components.

B. Develop student interest by having students work with models and mock-ups of various electrical systems in the laboratory.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
Lesson 1 A. Give an overview of the electrical systems and their chief function.	1. Four major electrical systems . . . ignition, charging, cranking and lighting and accessories . . . provide an integrated network of power, lighting and braking for safe convenient operation of the car. 2. All use storage battery as central source of power.	1. Basic concepts of electricity and magnetism. 2. Operation of magnets.
B. Ignition System.	1. Purpose of ignition system. 2. Flow of energy through components of ignition system. 3. Primary and secondary ignition circuits. 4. Common services needed in the ignition system. a. Check wires and terminals for good connections. b. Replace and set ignition points. c. Time the ignition. d. Clean, regap or replace spark plugs. e. Replace capacitor and distributor rotor. f. Replace ignition coil. g. Check ignition system with oscilloscope and other electronic test equipment.	1. Three elements needed for combustion. 2. How a transformer works to increase or decrease voltage. 3. Electromagnetism theory. 4. Conduction materials used in ignition wires. 5. Operation of the capacitor. 6. Difference between engine timing and ignition timing. 7. Theory of the stroboscopic light. 8. Insulating material used on plugs. 9. Diagnosis of engine performance from condition of spark plugs.
Lesson 2 C. Starting System.	1. Purpose of the cranking circuit. 2. Flow of energy through components of cranking circuit. 3. Types of cranking motor drives. 4. Services common to the cranking circuit: a. Check all connections and conductors. b. Check circuit continuity, voltage, and amperage. c. Check and replace ignition switch. d. Test and recharge or replace battery. e. Replace solenoid and cranking motor. f. Booster start with auxiliary battery. g. Composite testing by electronic analyzing equipment.	1. Solenoid operation. 2. Centrifugal force. 3. Electrical relationships of armature, fields, and brushes. 4. Convert electrical energy to mechanical energy. 5. Importance of making correct terminal connections (positive-positive, negative-negative).

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Compute wattage from amps, volts and ohms. 2. Generation of voltage and amperage by cutting lines of magnetic force.	1. Read and understand electrical diagrams. 2. Vocabulary of electrical terms. 3. Various marking and coding systems used to identify bulbs, wires, terminals and other electrical components.	1. The possibility of an "electric car" of the future.
1. Measure ignition coil voltage output. 2. Measurement of small distances with feeler gauge. 3. Selection of points and capacitor. 4. Set timing to specifications. 5. Concept of ignition point dwell angle. 6. Review size and design of terminal connectors. 7. Spark tests and gap measurements. 8. Effects of spark plug wear or malfunction on gas mileage. 9. Heat ranges on spark plugs.	1. Read 20,000 Volts Under the Hood. 2. Interpret automotive ignition specification chart. 3. Identify timing marks on American and imported vehicles. 4. Numbers and codes used to identify spark plugs. 5. Conversion tables for different plug manufacturers.	1. Discuss why the high correlation exists between ignition failure and auto service. 2. Impact of electronic diagnosis and troubleshooting an auto service industry. 3. The advantages of transistorized ignition. 4. Problem manufacturers have providing specifications to cover all types of driving behavior, elevation and climate. 5. Need for standardization of coding symbols in manufacturers products. 6. Importance of periodical tune-up to car owner.
1. Kinds of gears and gear ratios. 2. Measure torque. 3. Comparative costs of repairing part or using factory rebuilt part.	1. Read biography of Charles Kettering. 2. How to read multipurpose test instruments and gauges.	1. Use of auxiliary starting devices. 2. Significance of using low energy switches to activate high energy switches. Industrial applications of this. 3. Emergency road service such as towing and starting. Forms of insurance connected with road service policy.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Efficiency differences between generator and alternator. 2. Six and twelve volt generating and regulating systems.	1. Generator and alternator terminology. 2. Interpret electrical gauges and warning lights. 3. Discussion on G. M. booklet: <i>Electricity and Wheels</i>.	1. Milestones in automobile engineering. 2. Compare electrical systems on other vehicles such as aircraft, trains and vessels. 3. Compare type of auto service work done by service station, dealership and parts dealer.
1. Wire sizes and conductivity. 2. Fuse and circuit breaker capacities. 3. Compare braking efficiency of electric, manual and power braking systems. 4. Electric motors used an auto accessory systems. 5. Special prices on seasonal work to induce business.	1. What colored lights communicate to motorists. 2. How to look up replacement parts in a repair manual. 3. Parts ordering and back ordering procedures. 4. Maintain good working relations with the parts supplier.	1. Study types of lighting used on early vehicles. 2. Value of emergency blinker and signal lights on autos. 3. Identification of municipal vehicles by color of rotating light on roof of car. 4. Control of traffic by lights. 5. Social prestige of the "luxury" car. 6. Safe driving and courtesy on the road. 7. Accident prevention by use of caution lights, stop lights, and blinker lights, etc.

III. APPLICATION

Laboratory experience with service operations common to automotive service center problems.

- 1) Practice troubleshooting electrical problems.
- 2) Practice in solving electrical problems.
 - a) Charging and changing batteries.
 - b) Changing fuses, lights and light bulbs.
 - c) Cleaning and replacing spark plugs, cables, ignition points, capacitor and wires.
 - d) Testing circuits for opens, shorts and grounds.
 - e) Familiarization with test equipment.

IV. EVALUATION CRITERIA GUIDELINE

- A. Name some common services performed on the four electrical systems.
- B. Which systems seem to default most often? Why?
- C. Compare advantages and disadvantages of generator and alternator.
- D. How is generator output controlled?
- E. What is the purpose of a fuse? A breaker?
- F. What is polarity?
- G. Observation of student skills.

V. SUMMARY

In order for electricity to flow, it must have a circuit or path that is complete. Several circuits make up the electrical system of the automobile and each must function properly to provide satisfactory operation. These circuits are: ignition, starting, charging, lighting and accessories. The services performed by the service center employees are usually limited to replacement, cleaning and adjusting. Major operations should be performed by experienced personnel.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 20 minutes . . . Introduce, show and review film: **The Spark of Power.**
60 minutes . . . Utilization of other films, filmstrips or transparencies.
180 minutes . . . Laboratory experiences on electrical systems.
80 minutes . . . Integrated curriculum concepts.
20 minutes . . . Summary and evaluation.

III. APPLICATION

Laboratory experience with service operations common to automotive service center problems.

- 1) Practice troubleshooting electrical problems.
- 2) Practice in solving electrical problems.
 - a) Charging and changing batteries.
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 - c) Cleaning and replacing spark plugs, cables, ignition points, capacitor and wires.
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- 20 minutes . . . Introduce, show and review film: **The Spark of Power.**
60 minutes . . . Utilization of other films, filmstrips or transparencies.
180 minutes . . . Laboratory experiences on electrical systems.
80 minutes . . . Integrated curriculum concepts.
20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **AC Spark Plug Tune-Up Manual**, Flint, Mich.: AC Spark Plug Division of General Motors Corporation.
- 2) **Basic Automotive Electricity**, Service Department, Ford Division, Ford Motor Company, Dearborn, Michigan (Free on request).
- 3) **Better Ignition**, DR-5141, Delco-Remy Division, General Motors Corporation, Anderson, Indiana (Free in quantity).
- 4) **Champion Service and Installation Manual**, Toledo, Ohio: Champion Spark Plug Company (Free).
- 5) **Cranking Motors and Series Parallel Switches**, DR-5133C, Delco-Remy Division of General Motors Corporation, Anderson, Indiana.
- 6) **Electrical Fundamentals**, Education Services, Department of Public Relations, Chrysler Corporation, P. O. Box 1919, Detroit, Michigan.
- 7) **Facts About Spark Plugs and Engines**, Toledo, Ohio: Champion Spark Plug Company (Free on request).
- 8) **Fundamentals of Delcotron Generators (Alternators)**, DR-5133K, Anderson, Ind.: Delco-Remy Division of General Motors Corporation.
- 9) **Generators (DC Type)**, DR-5133E, Anderson, Indiana: Delco Remy Division of General Motors Corporation.
- 10) **Ignition Circuit, The**, DR-5133D, Anderson, Indiana: Delco-Remy Division of General Motors Corporation.
- 11) **Introduction to Automotive Electrical System**, DR-9010, Delco-Remy Division of General Motors Corporation, Anderson, Indiana: (Free on request in quantities up to fifty).
- 12) **Master Maintenance (Service Guide)**, Chicago: The Chek-Chart Corporation, 1968.
- 13) **Shellubrication Specification Guide Book**, Shell Oil Company, 1969.
- 14) **20,000 Volts Under the Hood**, DR19020, Anderson, Indiana: Delco-Remy Division of General Motors Corporation (Free in quantity).

INSTRUCTOR'S UNIT PLAN

Unit 9
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Muffler and Tailpipe Service

AIM: To develop an understanding of the nature and purpose of the automobile muffler and exhaust system. Also to develop skills in servicing the exhaust system.

INSTRUCTIONAL AIDS:

Film - **Combustion In Action**. Detroit: General Motors Corporation (19 minutes, 16 mm).

Transparencies - Set of teacher-made transparencies showing location and design of exhaust systems.

Cutaway of two basic types of mufflers.

EQUIPMENT:

16 mm projector and screen, auto chassis and mounted engines with exhaust systems intact.

PRIMARY REFERENCES:

- 1) Glenn, Harold T., **Automechanics**. Peoria, Ill.: Charles A. Bennett Company, Inc., 1962.
- 2) Stockel, Martin W., **Auto Mechanics Fundamentals**. Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 3) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**. Chicago: American Technical Society, 1967, Third Edition.

I. INTRODUCTION and MOTIVATION

Begin by introducing and showing film: **Combustion In Action**. Discuss exhaust gas production, its control and flow through the exhaust system. Move into discussion of the exhaust system design and components.

II. PRESENTATION of INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Function of the exhaust system.	1. To expell hot gases from the cylinders. 2. Dissipate combustion heat. 3. Control combustion noise. 4. Relationships of valve operation to exhaust process. 5. Safety aspects of automotive exhaust systems.	1. Fuel combustion. 2. Combustion chamber design to produce different patterns of combustion. 3. Effects of combustion efficiency on exhaust gases. 4. By-products of combustion. 5. Purpose of valve timing. 6. Effects of combustion heat on cylinder walls and other engine components. 7. Provisions for "breathing" ability of the engine. 8. Dangers of carbon monoxide gases. Its effects on human breathing. 9. How carbon monoxide is formed. 10. Baffle plate and glass-pack type mufflers. 11. Effects of back pressure on the engine.
B. Components of the exhaust system.	1. Components include: a. Exhaust manifold. b. Front, intermediate and rear exhaust pipe(s). c. Front and rear muffler (s). d. Resonators. e. Tailpipes. f. Gaskets, clamps, strips and hangers.	1. Material selection for system components. 2. Basic designs of exhaust systems. 3. Construction of exhaust components of farm and marine engines. 4. Coated type mufflers. 5. Resonator operation.
C. Exhaust system services.	1. Check system for leaks. 2. Patch holes, cracks or leaks in system. 3. Replacement of exhaust pipes, mufflers, resonators, tailpipes, hangers and clamps. 4. Engine diagnosis via exhaust system. 5. Special tools used to service exhaust systems.	1. Fiber glass patch kits. 2. Sealing the system by brazing joints. 3. Control of noise by insulation. 4. Observation of noise variations in exhaust systems which indicate malfunctions.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Combustion chamber temperatures. 2. Determine audible noise levels from combustion. 3. Comparison of exhaust temperatures at the tailpipe. 4. Determine exhaust valve timing and clearances. 5. Efficiency loss through the exhaust system. 6. Relative cost of exhaust system components based on volume car repair. 7. Removal of exhaust gases from work area to maintain minimum tolerable levels for personal health.		
1. Stock and inventory record keeping. 2. Estimate pipe lengths and clamp sizes. 3. Sizing of fastening devices.	1. Identification of part numbers and coding systems. 2. Locate information in telephone directory.	1. Structure work procedures when installing or repairing an exhaust system. 2. Tragedy of human deaths from carbon monoxide gas. Reports on suicidal cases.
1. Cost of parts. 2. Cost of labor.	1. Exhaust system terminology. 2. Control of customers bringing their own parts to service center and wanting to borrow facilities and tools or have center install system.	1. "Life of Car" muffler warranties. 2. State automotive inspection requirements of exhaust system. 3. Sonic induction and exhaust.

III. APPLICATION

Students should become familiar with the components of exhaust systems by following the film and demonstrations of common services and begin to practice these services on laboratory equipment.

IV. EVALUATION CRITERIA GUIDELINE

- A. What is the purpose of engine exhaust system?
- B. Identify components of the exhaust system.
- C. Describe diagnostic and troubleshooting procedures used to find leaks, repair joints and holes.
- D. Why are exhaust gases dangerous? How can these gases be controlled?
- E. What level of skill are students able to perform?
- F. What are the chief safety factors to observe when servicing an exhaust system?

V. SUMMARY

The burned gases are expelled from the cylinder through the exhaust manifold, exhaust pipe, muffler and tailpipe. An exhaust system is designed for three major functions: (1) To expel hot gases from the cylinders, (2) dissipate combustion heat and (3) control combustion noise levels.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 30 minutes . . . Introduce, show and review pertinent points of film: **Combustion In Action**.
- 180 minutes . . . Laboratory experience related to muffler and exhaust system inspection and replacement.
- 130 minutes . . . Integrated curriculum concepts.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Allen, W., **Know Your Car**, 2nd Ed., Chicago: American Technical Society, 1969.
- 2) Anderson, E., **Domestic Compact Auto Repair Manual**, Indianapolis, Ind.: Theodore Audel & Company, 1967.
- 3) Anderson, E., **Foreign Auto Repair Manual**, Indianapolis, Ind.: Theodore Audel & Company, 1967.

INSTRUCTOR'S UNIT PLAN

Unit 10
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION

DIVISION: AUTOMOTIVE SERVICES I

SUBJECT: **Filters and Filter Service**

AIM: To develop an understanding of the various types and purposes of filters, their location, operation and periodical services needed.

INSTRUCTIONAL AIDS:

Cutaway of oil, gasoline and air filters showing flow pattern of fluid through them. Charts showing different types of filters.

EQUIPMENT:

Samples of new and used filters, filter servicing tools and equipment and an engine with filters properly located.

PRIMARY REFERENCES:

- 1) **Air Filter Facts**, Rahway, N. J.: Purolator Products Inc., (free on request).
- 2) Crouse, William H., **Automotive Mechanics**, New York: McGraw-Hill Book Company, Inc., 1965, Fifth Edition.
- 3) **Engine Protection Through Lube and Fuel Filtration**, Flint, Mich.: AC Spark Plug Division of General Motors Corporation.
- 4) **Facts About Purolator Filters**, Rahway, N. J.: Purolator Products, Inc., 1966 (Free on request). Sufficient quantities for student use.

I. INTRODUCTION and MOTIVATION

Show students evidence of eroded or damaged engine parts caused by lack of filtering or faulty filtering systems. Develop the realization that filters protect and extend engine life.

II. PRESENTATION of INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Purpose of filters.	1. To remove dirt, sludge and foreign matter that would erode or damage engine.	1. Design of filters.
B. Air filters.	1. Three types: a. Oil bath b. Oil wetted c. Dry element 2. Air filter construction and materials. 3. Air filter service: a. Remove and clean filter element b. Replace filter (adding oil to oil bath and oil wetted types).	1. Flow of air through the three types of air filters. 2. Significance of air-fuel mixture in the carburetor; requires free flow of air. 3. Principle of oil bath and oil wetted type filters.
C. Fuel filters.	1. Two types: a. Fuel filtering elements in sediment bowls. b. Disposable type filters at inlets and in the fuel line. 2. Identify the many locations of inlet filters and those within the carburetor. 3. Services common to fuel filters include cleaning or replacement of elements. 4. Safety procedures to follow when servicing gasoline filters.	1. Need for maintaining fuel under pressure for better performance on today's cars. 2. Effects of dirty carburetor jets and orifices on fuel consumption and engine performance. 3. Design of filter elements to withstand gasoline. 4. Types of cleaners used for filter elements.
D. Oil Filters.	1. Types of oil filters: a. Replaceable element type. b. Screw-on type. 2. Services commonly needed on oil filters: a. Replace removable element type. b. Replace screw-on type. 3. Typical location of oil filter.	1. Flow of oil through filters. 2. Importance of making joints tight around filters. 3. Oil viscosity and flow through filters. 4. Filters for automatic transmission lines. 5. Composition of lubricating oils.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Savings to the consumer who uses filters to extend engine life.	1. Problems of selling the customer on value of filters and the need for periodical cleaning or changing.	1. Discuss how service center proprietors vary prices and profits on products to balance their total income. 2. What the handyman consumer can do in the general maintenance and service of filters for his own car.
1. Cost analysis of using each type of filter. 2. Determine correct amount of oil to use in oil bath or oil treated filters. 3. Intervals for changing air filters. 4. Sizes of air filters.	1. Use cross-reference catalogs and service manuals to determine appropriate filter.	1. Nature of drivers and driving conditions which require filtration on engines.
1. Principles and practices for inventory filters. 2. Sizes and shapes of fuel filters. 3. Intervals for changing fuel filters.	1. Differentiating filter uses from instructions and descriptions on packages.	1. The simple gravity feed fuel system used on early cars. 2. Advantages of pressurized fuel systems today. 3. General reaction of people to fires started in their cars and/or homes. 4. Social, emotional and psychological traits of service center employees.
1. Determine volume of oil needed in engine when filter is changed. 2. Intervals for changing oil filters. 3. How to sustain filter inventory in the center.	1. Determine location and type of oil filter from service manual. 2. Read the booklet: Engine Protection Through Lube and Fuel Filtration. 3. Sales and promotion of oil, fuel and air filters.	1. Need for mechanics to develop attitudes of care and concern for customer's vehicles. The customer needs to trust the mechanic. 2. The importance of cleanliness when changing filters of all types.

III. APPLICATION

Students should practice removing and replacing filters. Concentration on development of skills of cleanliness and speed in filter service is important.

IV. EVALUATION CRITERIA GUIDELINE

- A. Why are filters needed on today's cars more than on older models?
- B. What sort of problems does unfiltered dirt cause?
- C. Identify types of filters and their location on the car.
- D. What are common service intervals for air filters? Fuel filters? Oil Filters?

V. SUMMARY

Frequent and regular filter changes prevent unnecessary engine wear and repair costs. Clean filters can increase gas mileage, prevent engine misfire and stalling, keep proper lubrication on engine moving parts, extend service time on oil changes and most importantly, prevent erosion and damage to the engine and its components.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 40 minutes . . . Science concepts.
- 180 minutes . . . Laboratory experience working with and checking filters.
- 40 minutes . . . Math concepts.
- 40 minutes . . . Social studies concepts.
- 40 minutes . . . Communications concepts.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Cooke, David C., **How Automobiles Are Made**, New York: Dodd, Mead & Company, Inc., 1957.
- 2) Kuns, R. and Duvall, J., **Automotive Essentials**, New York: The Macmillan Company, 1969.
- 3) Wetzel, Guy F., **Automotive Diagnosis and Tuneup**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1965.

INSTRUCTOR'S UNIT PLAN

Unit 11

Lesson 1

Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Lubricants and Lubrication

AIM: To develop an understanding of the properties of oils as lubricants and the function and operation of the automotive lubrication system.

INSTRUCTIONAL AIDS:

Film - **The Way of Lubrication**, Berkeley, Calif.: University of California Film Library (23 minutes, 16 mm, color, sound).

Film - **Oil Films In Action**, Detroit: General Motors Film Library, General Motors Building (16 mm, sound).

Filmstrip - **The Engine Lubricating System**, 2821 E. Grand Blvd., Detroit: Jam Handy Organization (35 mm).

Filmstrip - **Principles of Lubrication**, #OE355FS, 1445 Park Avenue, New York: United World, Inc. (35 mm).

Transparencies - **Engine Lubrication AM-10, Universal Joint Types - Lubrication AM-39, Front Wheel Bearing Lubrication AM-20**, 4865 Stenton Avenue, Philadelphia 19144: DCA Educational Products, Inc.

Chart - Lubrication Wall Chart, 111 N. Brookhurst, Anaheim, California: Chrysler Corporation.

EQUIPMENT:

16 mm projector, filmstrip projector, overhead transparency projector, screen.

PRIMARY REFERENCES:

- 1) Allen, Willard A., **Know Your Car**, Chicago: American Technical Society, 1967, Second Edition.
- 2) Crouse, William H., **Automotive Fuel, Lubricating and Cooling Systems**, New York: McGraw-Hill Book Company, Inc., 1959.
- 3) Glenn, Harold T., **Automechanics**, Peoria, Ill.: Charles A. Bennett Company, Inc., 1962.

I. INTRODUCTION and MOTIVATION

- A. Introduce film **The Way of Lubrication**. Elicit student responses to directed questions about the concept of lubrication.
- B. Introduce film **Oil Films In Action** and discuss concepts presented using Engine Lubrication transparencies.
- C. Discuss lubrication of the engine and relate common elements of lubrication to aspects of chassis, front end and universal joint lubrication. Use **Universal Joint Types - Lubrication** and **Front Wheel Bearing Lubrication** transparencies.
- D. Have filmstrip **The Engine Lubricating System** available for individual or group study.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Effects of friction.	1. Concept of friction-heat. 2. Advantages of friction. 3. Disadvantages of friction.	1. Macrostructure and friction as related to surface smoothness. 2. How heat affects friction properties.
B. Engine and automatic transmission oils.	1. Wet friction. 2. Dry friction. 3. Reducing friction by oil in the automotive engine. 4. Detergent and non-detergent oils. 5. Single and multiple viscosity oils.	1. Treating surfaces to reduce friction. 2. Friction between similar and dissimilar materials. 3. Friction reduction by surface treatment. 4. Reduction of friction by oil. 5. Oil production from crude petroleum. 6. Oil viscosity properties. 7. Centrifuge testing.
C. Engine oil lubrication systems.	1. Splash system. 2. Full pressure system. 3. Combination splash and pressure. 4. Oil pump principles.	1. Liquid properties. 2. Positive displacement (liquid) pumps.
D. Servicing oil lubrication systems.	1. Oil changing. 2. Filter replacement. 3. Automotive engine flushing. 4. Oil pump inspection and replacement.	1. Effects of suspended particles and lubricants. 2. Oil "breakdown." 3. Oil additives.
E. Chassis lubrication.	1. Grease types, weights. 2. Grease connections and fittings. 3. Greasing procedures. 4. Prepacked joints. 5. Body lubrication.	1. Chemical structure of various greases. 2. How grease is manufactured. 3. Differences between lubricating properties of oil and grease.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Measuring tolerances of sliding and mating parts.	1. Be able to explain the concept of friction. Prepare a brief essay paper on importance of friction in industry.	1. How friction affects man's life. 2. Dependency on friction in the transportation field.
1. Pressure formulas. 2. Cost concepts of lubrication. 3. Measuring viscosities of oil. 4. Determining engine and automatic transmission capacities.	1. Reading technical literature on oils and lubrication systems. 2. Technical vocabulary of oils. 3. Advertising techniques of oil manufacturer.	1. The petroleum industries. 2. Industrial pipelines for transporting petroleum. 3. Social impact of the oil refining industries. 4. Problems of obtaining crude petroleum (offshore drilling, etc.).
1. Checking tolerances in the automotive oil pump.	1. Reading charts and manuals for oil lubrication systems.	
1. Cost concepts of servicing lubricating systems. 2. Liquid volume measurements. 3. Pricing oils.	1. Advertising techniques for service stations. 2. Reading technical manuals relating to lubrication system servicing.	1. Statistics of miles driven per day/week/month/year by: a. Average American. b. Salesmen. c. Truckers. d. And others.
1. Computing profits of lubrication servicing.	1. Reading technical manuals relating to front end lubrication.	1. Importance of periodical lubrication to automobile and hence, the consumer.

III. APPLICATION

- A. Experiments on the effects of friction.
- B. Disassembly and inspection of the lubrication system of the automobile.
- C. Disassembly, inspection and checking tolerances of the oil pump.
- D. Tracing the flow of oil through the engine.
- E. Changing the oil and filter of the automobile engine.
- F. Lubrication of the front end and chassis.

IV. EVALUATION CRITERIA GUIDELINE

- A. What is meant by the term friction?
- B. What is the difference between wet and dry friction?
- C. What is detergent oil?
- D. What are the four functions of engine oil?
- E. What are three ways of lubricating an engine?
- F. Why must the front end and chassis be lubricated periodically?

V. SUMMARY

- A. Engine friction is controlled through the use of lubricating oil. The oil separates the moving parts with a fine film.
- B. Oil cleans, cools, seals and lubricates the various components of the automobile engine.
- C. Even with filtering, oil must be changed periodically.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 180 minutes . . . Introduction and showing of Lubrication, oil films In Action and review of concepts.
- 60 minutes . . . Science concepts.
- 50 minutes . . . Math concepts.
- 30 minutes . . . Social studies concepts.
- 40 minutes . . . Communication concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Beeler, Samuel C., **Understanding Your Car**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1967.
- 2) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part 3 . . . The Power Flow**, Milwaukee: Bruce Publishing Company, 1964.
- 3) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part 4 . . . The Chassis Units**, Milwaukee: Bruce Publishing Company, 1964.
- 4) Bricker, Frederick E., **Automobile Guide**, Indianapolis: Theodore Audel & Company, 1967.
- 5) Cooke, David C., **How Automobiles Are Made**, New York: Dodd, Mead & Company, Inc., 1957.
- 6) Corbett, Scott, **What Makes A Car Go**, Boston: Little, Brown & Company, 1963.
- 7) Crouse, William H., **Automotive Transmission and Power Trains**, New York: McGraw-Hill Book Company, Inc., 1967, Third Edition.
- 8) Kuns, Ray F., **Auto Mechanics Course 2. Cooling, Lubricating and Fuel Systems**, Milwaukee: Bruce Publishing Company, 1955.
- 9) Kuns, Ray F. (Rev. by Duvall, Jack J.), **Automotive Essentials**, Milwaukee: Bruce Publishing Company, 1966.
- 10) **SC-337 Instructional Guide for Auto Mechanics**, Senior High School Industrial Education, Los Angeles City Schools, Division of Instructional Services, 1959, Revised Edition.
- 11) Stockel, Martin W., **Auto Mechanics Fundamentals**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 12) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**, Chicago: American Technical Society, 1967, Third Edition.

INSTRUCTOR'S UNIT PLAN

Unit 12
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Chassis Service

AIM: Upon completion of this unit, the student should be able to identify and service bearings, grease seals, ball joints and other chassis services.

INSTRUCTIONAL AIDS:

Transparencies - **Front End Assembly** (4 overlays - \$18.75), 4865 Stenton Avenue, Philadelphia 19144: DCA Educational Products, Inc.
Filmstrip - **Progress In Suspension Systems** (loan - free), P. O. Box 500, Hagerstown, Indiana 47346: Dana Parts Company, Hagerstown Distribution Center.
Chart - **Automobile Chassis** (22"x34" - free), Warren, Mich. 48090: Educational Relations Section, Public Relations Staff, General Motors Corporation, General Motors Technical Center.
Booklet - **Progress Through Steering** (free), Saginaw, Mich. 48605: Saginaw Steering Gear Division.

EQUIPMENT:

Overhead projector and screen, filmstrip projector, easel and thumbtacks and a cutaway or live chassis.

PRIMARY REFERENCES:

- 1) **Anti-Friction Bearing Maintenance**, 60 E. 42nd Street, New York 17, New York: Engineering Committees, Anti-Friction Bearing Manufacturers Association, Inc.
- 2) **Chassis Service Manual**, Detroit: Chevrolet Motor Division, General Motors Corporation, 1969.
- 3) **Handle With Care**, Ball Bearing Service Procedure Handbook, Bristol, Conn.: New Departure Division, General Motors Corporation.
- 4) **1968 Chevrolet Corvette Key Components**, Sandusky, Ohio: New Departure Hyatt Bearings, General Motors Corporation.
- 5) **Oil Seal Manual**, Chicago 60622: Chicago Rawhide Manufacturing Company, Service Sales Division.

I. INTRODUCTION and MOTIVATION

- A. Describe how to use a lubrication manual and chart. Use of the chart will enable students to see general locations of chassis service points and recommend types and proportions of lubricants to be used. Point out both chassis and under-the-hood lubrication points. Emphasize safety in use of the lift.
- B. Show filmstrip on **Progress in Suspension Systems** and lead into transparencies and lab work.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Matching the grease to the job.	1. Some greases have high water resistance, others have high temperature resistance. 2. Combinations of grease produced as multipurpose grease to fit many jobs. 3. Grease is a sealant that lubricates and excludes dirt and water.	1. How greases are made or refined. 2. Properties of different types of grease. 3. Molecular structure of Teflon. How it gets its lubricating characteristics.
B. Gear oil applications and requirements.	1. Three areas on the chassis require gear oils. a. Transmission (manual). b. Front and rear differentials. c. Steering box. 2. Properties of gear oils: a. Resistance to deterioration. b. Wide operating temperature range. c. Resist foaming. d. Load carrying. 3. Positraction differential oils.	1. Determining temperature range of gear oil. 2. Differentiate between gear oil and transmission fluid. 3. Viscosity of gear oils.
C. Lubricating rubber mounted parts.	1. Special lubricant needed because regular grease or oil will deteriorate rubber. 2. Silicone based lubricants are recommended. 3. Spray lubricants. 4. Special lubricants.	1. Effects of grease or oil on rubber bushings. 2. Lubricating characteristics of silicone and graphite lubricants.
D. Grease seals.	1. Seals are used at points where grease or oil may be lost or where water or dirt may enter. 2. Low pressure guns should be used to prevent seal blowout or damage.	1. Materials used in grease seals.
E. General services.	1. Chassis service points: a. Grease fittings at joints. b. Body lubrication points. c. Wheel bearings. d. Linkage. e. Accessory reservoirs. (power steering, etc.). f. Power train (transmission, differential, universals, etc.).	1. Single and multiviscosity oils.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Determining quantities used and prices to charge customer. 2. Ordering and figuring cost of lubricants. 3. Determining periodical lubrication service based on driving distance and conditions.	1. Use of proper lubrication terminology. 2. Ability to read lubrication charts. 3. Give attention to current periodicals in the automotive field. Watch for articles on lubricants.	1. Safety in the service center (grease on floor, oil leaks and spillage, etc.). 2. Development of Teflon bearings and its effect on parts industry. 3. "Sealed" bearings and fittings.
1. Determining quantities used and prices to charge customer. 2. Ordering quantities and figuring cost of bulk and individual cans of oils. 3. Compute cost of pneumatic lube equipment for service center.	1. Be able to write summary reports of activities to employer. 2. Ability to read capacity charts on oils and greases.	1. Matching gear oil to the geographic locality. 2. Use of gear oil and safety. 3. Effects of engineering changes on greases and oils (vis. development of hypoid oil to serve the hypoid gear).
1. Keep customer records of periodical services and notify customer in advance of time for next lubrication.	1. Devise a scheme to offer customers incentives to trade at the center or have more regular service.	1. Spraying rubber lubricant and eye safety. 2. Effects of contests, prizes, gifts, stamps, etc. on station management and customer interest.
1. Sizes and types of seals.	1. Ability to read order catalogs. 2. Writing orders for stock replacement.	
1. Make efficiency study of service center bay use.	1. Develop and use a lubrication check list to give customer as record of service.	1. Trends in auto service industry to provide extended customer service and convenience by pickup-delivery of car, customer lounge at center, etc.

III. APPLICATION

A. Following lecture . . . demonstrations on chassis servicing . . . have students begin activities involving actual experiences in lubrication and maintenance of the automobile chassis.

B. Have students list what lubricant should be used as the instructor points to various areas on the chassis chart.

IV. EVALUATION CRITERIA GUIDELINE

A. What guidelines are used for matching the grease or oil to the job?

B. How is viscosity of oils determined?

C. Where are the common lubrication points on a chassis?

D. How do grease seals work?

V. SUMMARY

Three main areas of the automobile chassis require lubrication . . . joints, bearings and rubber bushings. These areas require lubricants that are quite different. There are three areas that need gear oil . . . differential, transmission and steering box. Seals are used to prevent leakage and contamination.

VI. SUGGESTED TIME and SEQUENCE LISTING

40 minutes . . . Show filmstrip and transparencies.

180 minutes . . . Laboratory experiences and practice.

100 minutes . . . Related concepts in math, science, communications and social studies.

40 minutes . . . Summary and review of lesson.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Adler, Irving, **Tools In Your Life**, New York: The John Day Company, 1956.

2) Beeler, Samuel C., **Understanding Your Car**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1967.

3) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part Four . . . The Chassis Units**, Milwaukee: Bruce Publishing Company, 1964.

4) **Service Station Safety**, 1271 Avenue of the Americas, New York: American Petroleum Institute, API Accident Prevention Manual No. 5, Third Edition, August 1959.

5) Toboldt, William K. and Purvis, Jud, **Motor Services Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

INSTRUCTOR'S UNIT PLAN

Unit 13
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Brakes and Brake Fluids

AIM: Upon completion of this unit, the student should be able to service automotive brake systems based on hydraulic principles for confined fluids at rest and under pressure.

INSTRUCTIONAL AIDS:

Film - **Hydraulic Brake System**, 704 South Sixth Street, Champaign, Ill. 61822: Visual Aids Service, University of Illinois, Division of University Extension (11 minutes, B & W).

Filmstrip - **Basic Brakes**, Detroit: Ford Motor Company.

Filmstrip - **Hydraulic Brakes**, 2821 E. Grand Blvd., Detroit 48211: Jam Handy Organization, Kit C, Film No. 5.

Filmstrip - **Hydraulic Brakes**, No. OE483FS, 1445 Park Avenue, New York: United World Films, Inc.

Filmstrip - **Brake Drums and Shoes #2040-3; Brake Operating Linkage #2040-4; Hydraulic Brakes #2040-5; Power Brakes #2040-6**, 2821 E. Grand Blvd., Detroit 48211: Jam Handy Organization.

Loop Film - **Rebuilding the Master Cylinder, Replacing the Bendix Brake Shoes, Bleeding Hydraulic Brakes, Rebuilding Brake Wheel Cylinders**, 1212 Avenue of the Americas, New York: Modern Learning Aids (8 mm).

Slides - **Fundamentals of Brake Service**, Rock Island, Ill.: Bear Manufacturing Company.

Chart - "The Brake System," Warren, Mich.: Educational Relations Section, Public Relations Staff, General Motors Corporation, General Motors Technical Center.

Chart - "The Hydraulic Brake System," No. AS01183, 30 E. 42nd Street, New York: National Carbon Company.

Chart - "Hydraulic Brakes," Detroit: Educational Relations Section, Department of Public Relations, General Motors Corporation.

Transparencies - "Brakes," AM-17, AM-18, AM-24, AM-41, Phila.: DCA Educational Products, Inc.

EQUIPMENT:

Slide projector, 16 mm and 8 mm film projector, overhead projector, and screen, mock-up brake system for bleeding practice and an automobile to be used for inspection of all brake components.

PRIMARY REFERENCES:

- 1) Bear Manufacturing Company, **Bear Guide to Brake Service**, Rock Island, Ill.: Bear Manufacturing Company, 1966.
- 2) Grey-Rock, **Brake Service Manual for Cars-Trucks-Buses**, Manheim, Pa.: Grey-Rock Division of Raybestos-Manhattan, Inc., 1965.
- 3) Toboldt, William K. and Purvis, Jud, **Motor Service's Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

I. INTRODUCTION and MOTIVATION

- A. Show the slides followed by the wall charts and transparencies to set the stage for the lesson.
- B. Demonstrate the procedure used for bleeding brake system.
- C. Indicate what points should be inspected in the brake system components.
- D. Allow students to have actual experience with all the above.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Hydraulic principles of automotive braking systems.	1. System consists of master cylinder, wheel cylinders, steel tubing. 2. Brake pedal is pressed causing pressure buildup in master cylinder which pressurizes fluid in tubing and wheel cylinders. Wheel cylinders have pistons that expand brake shoes. 3. Hydraulic vs. electric brakes. 4. Disc brakes. 5. Self-adjusting brakes.	1. Boyle's, Pascal's and Bernoulli's laws. 2. Piston-to-piston movement ratio. 3. Fluid flow. 4. Analysis of brake fluid.
B. Brake system operation.	1. Reservoir is in master cylinder. 2. Provides storage space for reserve fluid to be used as brake lining wears. 3. Master cylinder cap is vented to allow expansion and contraction of the fluid without the formation of a vacuum. 4. Reservoir fluid levels should be maintained for proper operation. 5. Never spill brake fluid on the car finish! 6. Bleeding air out of the system. 7. Dual cylinder systems.	1. Pressure multiplication in the master cylinder. 2. Pressures and vacuums. 3. Effect of air trapped in hydraulic systems. 4. Braking assistance by down shifting.
C. Inspection of brake system.	1. Serviceman should inspect: a. Brake linings: 1) Riveted 2) Bonded b. Brake drums. c. Master cylinder. d. Wheel cylinders. e. Steel tubing. f. High pressure hoses. g. Power booster units. h. Pedal adjustment. 2. Service of brake system components should not be attempted by inexperienced personnel.	1. What causes scored brake drums? 2. How are high pressure hoses different from regular hoses? 3. Brake lining materials.
D. Emergency brake.	1. Adjustment of the cable.	1. Mechanical brake system. 2. Leverage.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Figuring pressure and piston areas to determine movement ratios. 2. Determination of pressure per unit area.	1. Use of accurate and correct terminology. 2. Interpretation of symptoms into corrective measures. 3. Rapport development with customers.	1. Legal aspects concerning brake repair. 2. Applications of hydraulic systems to automobiles and other transport vehicles. 3. Inspection requirements for brake systems. 4. Development of hydraulic brakes for automobiles.
1. Figuring costs for and ordering brake fluid and parts. 2. Increasing pressure in the master cylinder. 3. Measuring system capacity for fluid.	1. Reading directions on brake fluid cans (compatibility, etc.). 2. Reading repair manuals. 3. Reading instructions for bleeding brakes.	1. Development of extra emergency reservoir in master cylinders. 2. Refinement and production of brake fluids. 3. Job study: "Brake Repair Serviceman"
1. Measuring brake drum diameter (safety limits). 2. Measuring lengths of tubing and tubing diameter. 3. Determining wheel cylinder diameter safety limits. 4. Turning or "matching" new linings to drum.	1. Informing customers of work that needs to be done. 2. Reading specifications and part number charts. 3. Study research booklets available on braking and control systems.	1. New dimensions in braking and control systems for transport vehicles.
1. Measuring cable length for specifications.	1. Reading adjustment procedures.	1. Laws requiring emergency brakes.

III. APPLICATION

- A. Students should be able to bleed mock-ups of the braking system for check by instructor.
- B. Students should inspect brake system components of a car and should record faulty parts for review by instructor.
- C. Students should be able to replace brake lining and hone wheel cylinders.

IV. EVALUATION CRITERIA GUIDELINE

- A. What are advantages and disadvantages of hydraulic and electric brake systems?
- B. What symptoms should the customers watch for which will indicate brake malfunction or failure?
- C. What is the significance of stopping distances?

V. SUMMARY

The braking system operation is dependent upon the fluid in its lines. Brake pedal pressure causes a pressure in the system which expands wheel cylinder pistons and brake shoes. Shoes hit against the drums and cause friction for stopping.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 90 minutes . . . Introduce and show two of the films listed under instructional aids.
- 30 minutes . . . Give demonstration on brake system.
- 180 minutes . . . Give demonstration on brake system service.
- 40 minutes . . . Related concepts in science, math, communications and social studies.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **Brake Maintenance Manual**, 6400 Plymouth Ave., St. Louis, Mo.: Wagner Electrical Corporation.
- 2) **Brake Service Guide**, Bridgeport, Conn.: Raybestos Division, Raybestos-Manhattan, Inc.
- 3) **Brakes and How They Work**, Detroit: American Brakeblock Division, American Brake Shoe Company.
- 4) **Bendix Brake Restoration**, South Bend, Ind.: Bendix Automotive Service Division, Bendix Corporation, 1967.
- 5) **Delco Moraine Brake Service Manual**, Dayton, Ohio: Delco Moraine Division of General Motors Corporation (booklet).
- 6) **Delco Moraine Power Brake Service Manual**, Dayton, Ohio: Delco Moraine Division of General Motors Corporation (booklet).
- 7) **Quick Reference Brake Service Guide**, Detroit: American Brakeblock Division of American Brake Shoe Company.
- 8) **Single Piston Disc Brake Service Manual**, Detroit: Delco Moraine Division of General Motors Corporation, 1967.

INSTRUCTOR'S UNIT PLAN

Unit 14
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Fuel System Operation and Service

AIM: To develop a basic understanding of the operation and service of the components in the automotive fuel system.

INSTRUCTIONAL AIDS:

Film - **The Fuel System**, 100 Park Avenue, New York: Ethyl Corporation (22 minutes, 16 mm, color).

Film - **The ABC's of Internal Combustion**, Detroit 48202: General Motors Film Library, General Motors Building (19 minutes, 16 mm).

Filmstrip - **The Carburetor** #2020-4 and **Fuel Feed System** #2020-5, 2821 E. Grand Blvd., Detroit: Jam Handy Organization (35 mm).

Loop Film - **Cleaning the Fuel Pump and Carburetor Adjustments**, 70 Furze-hill Road, Boreham, Wood, Herts, England: Eothen Films Limited (8 mm).

Loop Film - **Carburetor Idle Adjustment, Servicing the Automatic Choke, and Testing the Fuel Pump**, 1212 Avenue of the Americas, New York: Modern Learning Aids (8 mm).

Transparencies - **Fuel System** AM-1, **Carburetor Circuit's** AM-2, AM-3 and AM-4, **The Mechanical Fuel Pump** AM-25, Phila.: DCA Educational Products, Inc.

Chart - **Automotive Fuel System**, Detroit: Educational Relations Department, General Motors Corporation.

Chart - **Gasoline Economy**, Detroit: Chrysler Corporation.

EQUIPMENT:

16 mm projector, 35 mm filmstrip projector, 8 mm loop film projector, over-head projector and screen.

PRIMARY REFERENCES:

- 1) Allen, Willard A., **Know Your Car**, Chicago: American Technical Society, 1967, Second Edition.
- 2) Stockel, Martin W., **Auto Service and Repair**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1969.
- 3) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**, Chicago: American Technical Society, 1967, Third Edition.

I. INTRODUCTION and MOTIVATION

A. Begin class with introduction of film, **The ABC's of Internal Combustion**. Discuss film and bring out main points.

B. Show film, **The Fuel System**, to create a basic understanding of components of the automotive fuel system and their operation. Discuss film using transparencies: **Fuel System**, **Carburetor Circuits** and **Mechanical Fuel Pump** to illustrate concepts.

C. Follow with laboratory experiences.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Characteristics of fuels.	1. Fuels and octane ratings: a. Regular. b. Intermediate. c. Premium. d. Blended octanes. 2. Leaded and unleaded fuels. 3. Source of automotive fuels.	1. Octane rating of fuels. 2. Safety considerations in high and low octane fuels. 3. Molecular structure of different fuels. 4. Waste gases produced by various fuels during combustion. 5. Pollution resulting from leaded gasoline. 6. Petroleum refining process. 7. Effects of water condensation in storage tanks.
B. Components and function of the fuel system.	1. Trace flow of fuel through system. Describe function of system. 2. Basic components of fuel system: a. Fuel tank. b. Fuel lines. c. Fuel pumps (electric and mechanical). d. Carburetor and its internal circuitry. e. Intake manifold. f. Sediment filters. g. Replaceable in-line filters. h. Air filter on carburetor.	1. Fuel flow and evaporation. 2. Materials used in components, i. e., fuel lines, carburetor, tank, etc. 3. Venturi principle in the carburetor. 4. Maintaining float level. 5. Why fuel tank needs to be vented. 6. Temperature of fuels and combustion efficiency. 7. Reason for pressurized fuel system.
C. Servicing the fuel system.	1. Clean and adjust carburetor. 2. Check fuel lines for deterioration and obstructions. 3. Check fuel pump pressure and volume. 4. Check fuel tank vent and gauge. 5. Clean or replace sediment filters.	1. Effects of vacuum and pressure differentials on fuel flow. 2. Necessity of ventilation in the fuel tank. 3. Fuel additives and dry gas.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Measuring fuels by barrels, gallons, tank load, etc. 2. Octane mixtures and proportions. 3. Computing costs of vehicle operation based on fuel consumption. 4. Variations in volume of fuel purchased due to expansion and contraction.	1. Advertising techniques used by gasoline manufacturers. 2. Technical terminology used in petroleum industry. 3. Reading literature related to fuels and petroleum refining.	1. Federal and state taxing and use of taxes from gasoline. 2. Geographic locations of petroleum refineries in the U. S. and Europe. 3. Location of crude oil sources and the economic and political effects created by desire to control these resources.
1. Measuring liquids by weight and volume. 2. Mixture ratio of fuel and air. 3. Compare electric fuel pump with mechanical pump in terms of continuous volume and pressure.	1. Study combustion efficiency differences between automobile and diesel engines. 2. Talk with mechanics who have worked on fuel systems previously.	1. Federal legislation and interest in automotive pollution standards and control. 2. Transportation of petroleum and natural gas by pipelines in the U. S. 3. Trucking operations and standards for transporting gasoline.
1. Effects of fuel expansion and contraction on mileage. 2. Costs of servicing the fuel system (parts, labor, overhead, etc.). 3. Interpreting scales and measurements used in carburetor adjustments.	1. Be able to read service specifications, measurements and instructions.	1. Importance of providing quality service to the customer.

III. APPLICATION

A. Student should gain experiences related to the study of the various components of the fuel system. A few are suggested below.

1. Carburetor and fuel pump disassembly, inspection and reassembly.
2. Combustion analysis of:
 - a. Hi-low octane fuels.
 - b. Leaded-unleaded fuels.
3. Inspection of various fuel tanks, lines and intake manifolds.
4. Assembly of a mock-up fuel system.

IV. EVALUATION CRITERIA GUIDELINE

- A. Why is a fuel tank vent required?
- B. How are gasolines sold?
- C. Which device in the fuel system is responsible for metering the fuel-air mixture?
- D. Trace the flow of fuel from the tank to its destination in the combustion chambers.
- E. Why are gasolines available in different octane ratings?

V. SUMMARY

- A. Fuel systems are composed of a fuel tank, fuel lines, fuel pump carburetor and intake manifold.
- B. Fuels are sold by their octane ratings.
- C. The larger high compression engines require high octane fuels to insure better performance.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 90 minutes . . . Introduce, show and review films **ABC's of Internal Combustion, The Fuel System** and review using transparencies **Fuel System, Carburetor Circuits and Mechanical Fuel Pump.**
- 40 minutes . . . Introduce and show filmstrips: **Fuel Feed Systems and The Carburetor.**
- 160 minutes . . . Laboratory experiences.
- 50 minutes . . . Integrated curriculum concepts.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part Two . . . The Fuel and Electrical Systems**, Milwaukee: Bruce Publishing Company, 1964.
- 2) Christy, John, **Super Tuning**, New York: The New American Library Inc., 1966.
- 3) **Fuel Oil and High RPM Diesel Engines**, Detroit: Detroit Diesel Engine Division of General Motors Corporation, (no date).
- 4) Wetzel, Guy F., **Automotive Diagnosis and Tune-Up**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1965

INSTRUCTOR'S UNIT PLAN

Unit 15
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION

DIVISION: AUTOMOTIVE SERVICES I

SUBJECT: Exhaust and Emission Control System Service

AIM: To develop an understanding of and skill in identifying and servicing exhaust and emission control systems.

INSTRUCTIONAL AIDS:

Film - **Air Pollution and Cars**. Detroit 48202: General Motors Corporation, Public Relations Staff, Film Library, General Motors Building (loan, free).
Film - **Positive Crankcase Ventilation**. 100 Park Avenue, New York: Ethyl Corporation (22 minutes, 16 mm).

EQUIPMENT:

16 mm film projector and screen, sample PCV valves and crankcase ventilation system mock-up.

PRIMARY REFERENCES:

- 1) **Chassis Service Manual**. Detroit: Chevrolet Motor Division, General Motors Corporation, 1969.
- 2) **Crankcase and Exhaust Emission Systems**. Flint, Mich. 48556: AC Spark Plug Division, General Motors Corporation, 1969.
- 3) **Service Information for Engineered Performance**. United Delco, United Motors Service, #3, 1967.

I. INTRODUCTION and MOTIVATION

- A. Present the film **Air Pollution and Cars** and discuss general pollution and controls that should or are being levied on automobiles.
- B. Show next film: **Positive Crankcase Ventilation** and follow with demonstration of engines with and without exhaust emission control devices.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Exhaust system components.	1. Exhaust manifold is attached to cylinder head to collect gases from cylinders. 2. Exhaust pipe carries fumes from manifold to muffler. 3. Muffler . . . two types: a. Straight through. b. Baffle. 4. Muffler reduces noise and temperature of gases. 5. Tailpipe carries fumes from muffler beyond passenger compartment. 6. System carries deadly CO fumes and unburned hydrocarbons away from passengers.	1. Fuel combustion. 2. Flow of gases in piping. 3. Types of fuel vs. amount of CO produced. (lead vs. lead free) 4. Effect of backpressure upon engine performance.
B. Exhaust emission control devices.	1. Crankcase must be vented to remove fumes. 2. Vent tube allows fumes to escape into the air. 3. Positive crankcase ventilation recirculates the fumes and burns them. a. Internal valves. b. External valves. 4. Four types in use: a. Air-guard system. b. Cleaner air package. c. Thermactor. d. Air injector reactor.	1. Effect of fume recirculation upon performance. 2. Oil breakdown in relation to the draft tube and the PCV system.
C. Servicing the systems.	1. Replace PCV valve if faulty. 2. Adjust idle mixture screws in carburetor. 3. Replace components.	1. Engine wear and the clogged PCV system.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Ordering and figuring costs of parts and service. 2. Measuring pipe sizes. 3. Determining pipe size for maximum performance or efficiency.	1. Ordering parts. 2. Use of terminology related to exhaust and PCV systems.	1. Job study: "How exhaust systems are designed and constructed." 2. State inspection requirements of exhaust systems. 3. Safety of the passengers concerning CO gas. 4. Comparison of exhaust gases emitted from rotary and reciprocating engines.
1. Reading meters and interpreting combustion analyzers. 2. Saving on gas mileage by keeping PCV valve clean and serviced.	1. Relating to customer how system works. 2. Reading manuals for servicing different units.	1. Federal and state legislation concerning exhaust emission control devices and pollution. 2. Study of smog and pollution. 3. Cost of pollution control devices and the effect upon consumers.
1. Measuring engine vacuum for purpose of PCV adjustment and to determine valve guide wear.	1. Reading part numbers from specification listings. 2. Reading adjustment procedures and specifications.	1. Geographic location and pollution controls. 2. Current national legislation on pollution controls.

III. APPLICATION

- A. Students should be able to perform basic diagnosis and services on exhaust emission control devices.
- B. Assign a short written report or essay dealing with the topic: "How I Feel About Pollution and Controls."

IV. EVALUATION CRITERIA GUIDELINE

- A. Identify the major exhaust system components.
- B. How does the positive crankcase valve work?
- C. What safety precautions need to be observed which are related to the exhaust system?
- D. How can the exhaust system be redesigned to reduce pollution further?

V. SUMMARY

- A. Exhaust systems reduce noise as well as remove gases to the rear of the passenger compartment. Newer engines are equipped with emission control devices that reroute unburned gases and fumes to be burned more completely.
- B. Review material and service procedures.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 30 minutes . . . Show film: **Air Pollution and Cars**.
- 30 minutes . . . Introduce and show film: **Positive Crankcase Ventilation**.
- 180 minutes . . . Laboratory experiences with exhaust and PCV systems.
- 90 minutes . . . Related concepts in math, science, social studies and communications.
- 30 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part One . . . The Engine**, Milwaukee: Bruce Publishing Company, 1964.
- 2) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part Two . . . The Fuel and Electrical Systems**, Milwaukee: Bruce Publishing Company, 1964.
- 3) Rogers, Don E., **Engines: Progress and Power**, Racine, Wisc.: Whitman Publishing Company, 1962.
- 4) Toboldt, William K. and Purvis, Jud, **Motor Services Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.
- 5) Wetzel, Guy F., **Automotive Diagnosis and Tune-Up**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1965.

INSTRUCTOR'S UNIT PLAN

Unit 16
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Windshield Wiper and Washer Service

AIM: Upon completion of this unit, the student should be able to service windshield wipers and washers and troubleshoot problems or malfunctions.

INSTRUCTIONAL AIDS:

Slides - Teacher-made slides on windshield washers and wipers.

Filmstrip - **The Windshield Wiper Profit Story**, Gary, Ind.: The Anderson Company (35 mm).

EQUIPMENT:

Slide and filmstrip projector and screen. Windshield wipers, motors, washers and blades.

PRIMARY REFERENCES:

- 1) Bulletins . . . **Wiper Motors** . . . Nos. 18D-115, 116, 117, 117-2, 117-3, 117-3A and 117-4, Dayton, Ohio 45401: Delco Products, Division of General Motors Corporation.
- 2) Bulletins . . . **Washer Pumps and Motors** . . . Nos. 18D-117-5, 125-5, 135, 136 and 137, Dayton, Ohio 45401: Delco Products, Division of General Motors Corporation.
- 3) Heitner, Joseph, **Automotive Mechanics**, Princeton, N. J.: D. VanNostrand Company, Inc., 1967.

I. INTRODUCTION and MOTIVATION

Discuss experiences with faulty wipers and dirty windshields. Students should be able to contribute personal incidents of this type. Focus on safety problem of not having clear windshield visibility.

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Construction of wiper blades and arms.	- Parts of the wiper blade: - Rubber section - Blade case - Yoke - Connector - Types of wiper arm connectors: - Pin type - Wrist action - Bayonet type - Side lock - Types of wiper replacements: - Refill blades - Replaceable wiper assembly - Types of wiper driver shafts: - Wormed shaft - Threaded shaft - Check blades often. Selling replacements builds profits. - Winterized blades.	- Leverage and linkage design. - Effect of washer solvent upon rubber blades. - Advantages and disadvantages of each type of connector.
B. Windshield wiper power units.	- Types of power units: - Vacuum operated - Hydraulic - Electric - Never force blades to the parked position. Damage to motor or linkage can result.	- Motors, gears, and speed ratios. - Pneumatic and hydraulic principles operating on wiper assemblies.
C. Windshield washer units.	- Units are usually powered the: - Wiper motor - Separate electric motor - Manual pedal pushed by the driver. - Tubes may become cracked or clogged. Nozzles may become corroded. - Fluid levels should be maintained with proper solvents.	- Use of antifreeze as solvent. - Effect of solvent upon hoses and nozzles. - Other solvents.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Profit concept development. 2. Ordering of supplies.	1. Reading service manuals and parts tables. 2. Reading installation directions. 3. Use of proper terminology concerning wiper blades, power units, and washer units. 4. Ability to relate to the customer what is wrong with a unit.	1. Safety requirements concerning visibility. 2. State inspection requirements. 3. Job study: "Assembly Line Worker" "Anco Windshield Wiper Salesman."
1. Figuring gear ratios for different speeds. 2. Computing distances and force to determine leverage problems.		1. Type of wiper unit used during various time periods in history. (Economic Impact)
1. Measuring amounts of anti-freeze. 2. Positive and negative numbers (above and below zero).	1. Reading charts for determining amounts of antifreeze. 2. Interpreting scales and charts involving levels of protection.	1. Development of the windshield washer. 2. Product study: "Which of the three power sources is most efficient?"

III. APPLICATION

A. Students should have actual experiences with service or replacement of faulty windshield wiper motors, linkage, washers, wiper arms and blades and switches.

IV. EVALUATION CRITERIA GUIDELINE

A. Identify primary conditions calling for service and repair of wiper assemblies.

B. What hazards exist when driving with faulty wiper and washer equipment?

C. Student skill and accuracy in servicing units.

V. SUMMARY

A. Weather wears wiper blades. Emphasis upon safety will help the attendant to gain respect of the customer. Profits will also increase. Solvent level should also be checked whenever the oil is checked. A sale of solvent may be made. Never use engine antifreeze in the washer because of possible damage to the windshield.

VI. SUGGESTED TIME and SEQUENCE LISTING

30 minutes . . . Introduce and show filmstrip: **The Windshield Wiper Profit Story.**

180 minutes . . . Lab experiences.

130 minutes . . . Related concepts in math, science, social studies and communications.

20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Job Sheets . . . Part Four . . . The Chassis Units**, Milwaukee: Bruce Publishing Company, 1964.

2) **Chassis Service Manual**, Detroit: Chevrolet Motor Division, General Motors Corporation, 1969.

3) Hyde, Margaret O., **Driving Today and Tomorrow**, New York: McGraw-Hill Book Company, Inc., 1965.

4) Toboldt, William K. and Purvis, Jud, **Motor Service's Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

INSTRUCTOR'S UNIT PLAN

Unit 17
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Interior and Exterior Car Care

AIM: Upon completion of this unit, the student should be able to care for car interiors and exteriors, to improve service station capabilities and profits, and to care for automotive finishes.

INSTRUCTIONAL AIDS:

Teacher-made transparencies and slides on body interior and exterior.

EQUIPMENT:

Samples of upholstery, fenders, waxes, cleansers, etc., overhead projector, slide projector, screen and automobile.

PRIMARY REFERENCES:

- 1) **Automotive Finishes**, Cleveland, Ohio: Sherwin-Williams Automotive Finishes, 1968.
- 2) **Ditzler Repaint Manual**, Detroit: Ditzler Color Division, Pittsburgh Plate Glass Company, 1965.
- 3) **Fisher Body Service Manual 1970**, Detroit: Fisher Body Division, General Motors Corporation, August, 1969.

I. INTRODUCTION and MOTIVATION

- A. Discuss the increased value in dollars and cents of an automobile that has had proper care on exterior and interior.
- B. Using teacher-made slides and transparencies, demonstrate spot removal (interior) and method of polishing and waxing (exterior). Allow students to experiment to find best method.
- C. Demonstrate tar removal and care of soft trim.

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Care of automobile interiors.	1. Vacuum must allow for entrance of air because auto carpets are rubber-backed and do not allow passage of air. 2. Fabric upholstery may be vacuumed and vinyl may be cleaned with soap and water. 3. Interior cleaning should include: windows, ash trays, dash, sun visors, rugs, seats, door edges and jambs. 4. Special cleaning agents may be used on upholstery for spot removal. Make sure agent will not damage material. 5. Always use seat and floor protective covers when servicing the vehicle. 6. Silicone compounds may be used to protect floors and fabrics. 7. Use of seat covers and decorative upholstery.	1. Chemical breakdown of waxes, polishes. 2. Silicone compounds and their protective properties. 3. How spot removers work.
B. Cleaning the exterior finish.	1. Car washing can be provided with other services to help insure continuous work for employees. 2. Additional customer needs may also be found. 3. Also develops good customer relationships and builds profits.	1. Types of finishes and properties of each. 2. Types of cleansers used for washing.
C. Waxing and polishing.	1. Polishing should be finished first. 2. Paint may have to be compounded if it is very weathered. 3. Waxing should be the final operation.	1. Abrasives and car finishes. 2. Why use abrasives in a sequence?
D. Special lubrication.	1. Glove compartment door hinge. 2. Front and rear door hinge assemblies. 3. Door lock fork bolt. 4. Door jamb switch. 5. Lock mechanisms. 6. Window mechanisms. 7. Seats and tailgates. 8. Hood and trunk lid catches.	1. Friction and metal to metal contact. 2. Science of fasteners and cranking assemblies.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Profit building and additional services. 2. Ordering and figuring costs for supplies. 3. Comparative costs of cleaning materials and labor.	1. Ability to read instructions on cleaners, waxes, polishes, etc. 2. Design and make posters which call attention to the car interior and the value of keeping it clean. 3. Show customers your concern for the interior of their car by using shop seat covers and fender covers when working on the car.	1. The automobile as a status symbol in the U.S. 2. Job study: "Assembling Car Interiors" 3. "Interior designing of 'economy' cars and 'luxury' cars." 4. Automotive interior and upholstery trade skills. 5. Study types of interior design preferred by various age levels.
1. Operation and management of car wash centers.	1. Ability to communicate with customer and explain what the car needs.	1. Development of automotive parts. 2. Job study: "Car Wash Employees"
1. Estimating time needed for different jobs (task analysis).	1. Selling additional services to build profits and customer relationships.	1. Development of polishes and waxes for automotive finishes.
1. Figuring costs for lubrication of body parts.	1. Reading of body service manuals.	

III. APPLICATION

- A. Have students prepare a finished metal part by polishing/compounding and waxing.
- B. Have students clean an automobile interior and exterior.

IV. EVALUATION CRITERIA GUIDELINE

- A. What causes oxidation of body enamels and lacquers and how can this be retarded?
- B. What is the value of washing, cleaning, polishing and waxing a car?
- C. What are some special cleaning agents for removing tar, pitch and other foreign matter from the car?

V. SUMMARY

- A. The offering of additional services helps both the owner and the customer.
- B. Stress the value of keeping a car clean and attractive.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 60 minutes . . . Presentation of slides and demonstrations.
- 180 minutes . . . Lab experiences with cars.
- 100 minutes . . . Related concepts in science, math, communications and social studies.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **Binks Spray Manual**. Chicago: Binks Manufacturing Company, 1968.
- 2) **Ditzler General Painting Instructions**. Detroit: Ditzler Color Division, 1965. 1965.
- 3) **Refinish Materials**. Detroit: Ditzler Color Division, 1965.
- 4) **Spray Glaze Instruction Manual**. Wilmington, Del.: E. I. du Pont de Nemours & Co., Inc., 1957.
- 5) Toboldt, William K., **Auto Body Repainting**. Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.
- 6) Toboldt, William K. and Purvis, Jud, **Motor Service's Automotive Encyclopedia**. Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

INSTRUCTOR'S UNIT PLAN

Unit 18
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: **Tire and Wheel Balancing Services**

AIM: Upon completion of this unit, the student should be able to balance a tire statically and dynamically for best tire wear.

INSTRUCTIONAL AIDS:

Filmstrip - **Wheel Balancing**, 2021 E. Grand Blvd., Detroit: Jam Handy Organization.

Slides - **Wheel Balancing**, Rock Island, Ill.: Bear Manufacturing Company.

Film - **Coming Down the Road**, Houston: Humble Oil and Refining Company (22 minutes, 16 mm).

EQUIPMENT:

Filmstrip projector, slide projector, screen, static bubble balancer, dynamic balancer and several mounted tires.

PRIMARY REFERENCES:

- 1) **Chassis Service Manual**, Detroit: Chevrolet Motor Division, General Motors Corporation, 1969.
- 2) Toboldt, William K. and Purvis, Jud, **Motor Service's Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

I. INTRODUCTION and MOTIVATION

- A. Introduce and show filmstrip **Wheel Balancing**. Follow with discussion of filmstrip.
- B. Demonstrate how wheel balancing saves tread wear.
- C. Make slides on **Wheel Balancing** available to students for independent use during period.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Static wheel balance.	1. When in static balance, a tire and wheel assembly are in perfect balance when allowed to rotate about an axle. 2. The wheel has no heavy point when balanced. 3. A tire that is statically out of balance causes the wheel to hop. 4. Use of weights offsets the heavy points.	1. Vector analysis and balance. 2. Centrifugal & centripetal forces. 3. Effect of tire size upon degree of unbalance.
B. Dynamic wheel balance.	1. Insures perfect running balance of tire and wheel. 2. Different types of wheel balancing equipment. 3. Wheels must be statically balanced first. 4. Unbalance dynamically may be caused by heavy spots or breaks in the sidewalls. 5. Dynamic unbalance causes vibration, shimmy and wobble. 6. Use of weights offsets unbalance.	1. Control of heavy spots in tire manufacturing.
C. Safety and economics of wheel balancing.	1. Imbalance may cause: a. Excessive tire wear. b. Wear in wheel bearings. c. Ball joint wear. d. Steering gear wear. e. Tie rod ends wear. 2. Safe vehicle operation requires wheel balancing. 3. An excellent profit builder.	1. Effects of vibration upon part wear.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Geometry of wheel balancing (static). 2. Determining wheel weight size and costs.	1. Selling wheel balancing services. 2. Developing good customer relations through good personnel relations.	1. Quality control of heavy spots in tire industry. 2. Development of need for static tire balancing. 3. Extent and location of tire manufacturers. 4. Government concern with the grading systems.
1. Geometry of dynamic wheel balancing. 2. Comparison of tire life when balanced and when unbalanced.	1. Selling customers on the need for well balanced tires.	1. Development of need for dynamic tire and wheel balancing. 2. Importance to customer of balancing all new tires and wheels.
1. Costs and profits of wheel balancing services.	1. Emphasizing safety to customer.	1. State inspection of loose front end.

III. APPLICATION

- A. Students should have experiences with static and dynamic wheel balancing.
- B. Students should be able to identify tire wear with types of unbalance.

IV. EVALUATION CRITERIA GUIDELINE

- A. How do static and dynamic balance compare?
- B. Why is tire balancing a good investment for customers?
- C. Identify the safety factors inherent in wheel balancing.

V. SUMMARY

Tire unbalance may threaten the safety of the vehicle occupants. It may also cause undue wear on front end parts and tires. These results may cause excessive repairs and expenditures for your customer.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 180 minutes . . . Lecture-demonstration, student activity.
- 70 minutes . . . Science concepts.
- 50 minutes . . . Math concepts.
- 30 minutes . . . Communications concepts.
- 30 minutes . . . Social studies concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **America On the Move**, Saginaw, Mich.: Saginaw Steering Gear Division, (Booklet).
- 2) Beeler, Samuel C., **Understanding Your Car**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1967.
- 3) Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part Four . . . The Chassis Units**, Milwaukee: Bruce Publishing Company, 1964.
- 4) Crouse, William H., **Automotive Mechanics**, New York: McGraw-Hill Book Company, Inc., 1965, Fifth Edition.
- 5) Toboldt, William K. and Purvis, Jud, **Motor Service's Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.

INSTRUCTOR'S UNIT PLAN

Unit 19
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION
DIVISION: AUTOMOTIVE SERVICES I
SUBJECT: Servicing Tube and Tubeless Tires

AIM: Upon completion of this unit, the student should be able to dismount, service and mount tube and tubeless tires.

INSTRUCTIONAL AIDS:

Transparencies - "Wheels and Tires" Nos. AM-22, 23, 43 and 44, Philadelphia: DCA Educational Products, Inc.

Cutaway tire, tubes, rim.

Film - **Tire Performance**, Buffalo, N. Y.: Dunlop Tire and Rubber Corporation (12 minutes, 16 mm, color, sound).

Loop Film - **Care of Tires**, Toronto, 12, Canada: Moreland-Latchford Productions, Ltd. (8 mm).

Loop Film - **Tire Construction. To Remove and Replace a Tire. To Remove and Replace the Complete Front Wheel**, Tronto 12, Canada: Moreland-Latchford Productions, Ltd. (8 mm).

EQUIPMENT:

16 mm film projector, 8 mm projector, overhead projector and screen.

Tire changer, tube repair kit and plugs.

PRIMARY REFERENCES:

- 1) **Car Care Manual**, Houston: Continental Oil Company.
- 2) **Customer Guide to Tire Safety**, New York: Rubber Manufacturers Association (Booklet).
- 3) **Puncture Repair Poster and Manual**, New York: Rubber Manufacturers Association.
- 4) **Tire Guide**, Farmingdale, New York: Tire Guide Publishers (Booklet).

I. INTRODUCTION and MOTIVATION

- A. With use of the transparencies, explain basic tire construction and methods of plugging holes.
- B. Demonstrate how to patch tire tubes and how to fit tubes into tires when mounting.
- C. Also demonstrate how to mount tires and how to inflate tubeless tires.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Tubeless tire repair: 1. Tire leaks. 2. On-wheel repair 3. Off-wheel repair.	1. Nails or other objects should be removed and marked if the tire is leaking. 2. Leakage may result from: a. Damaged valve core or valve. b. Cord separation. c. Cuts or cracks in sidewalls. d. Punctures. e. Failure to set properly on rim. 3. On-rim repair includes gum injection, rubber thread and plugs. 4. Off-the-wheel repair includes hot and cold patches.	1. Pneumatic principles. 2. Charles' law, Boyle's law. 3. Tire materials. 4. Principles of adhesion and cohesion.
B. Tube repair.	1. Hot or cold patch methods. 2. Valve stem replacements.	1. Principles of vulcanization.
C. Special tire repair.	1. Special tires should be repaired according to manufacturer's specifications and procedures.	1. Structure of racing tires (radial ply construction).
D. Mounting and dismounting tubeless and tube-type tires.	1. Be careful that: a. No damage to tire or rim occurs. b. Bead and rim seal properly. c. Proper valve stems are used. 2. Never use tire irons to break bead from rim. 3. Always use care when mounting or dismounting tires with tubes so as not to pinch the tube. 4. Tube valve must also be positioned correctly. 5. Proper inflation procedures. 6. Studded winter tires.	1. Tire structure. 2. Rim structure: a. Mag wheels. 3. Rubber types. 4. Tread design vs. wear. 5. Use of plastics in tires (nylon, polyglas).
E. Mounting and dismounting large truck and bus tires.	1. Always be safety conscious and use extreme caution. 2. Demountable rim flanges require careful handling because they are made of spring steel. 3. All air must be removed before removing the rim flange. 4. Use a safety cage for removing and mounting.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Pressure reading about air tank gauges and tire gauges. 2. Tire and tube sizes, ordering, selling, costs. 3. Timing for patch setup. 4. Measuring rim and valve stem diameter. 5. Cost difference between patches and plugs.	1. Ability to sell tires to increase profit. 2. Use of correct terminology. 3. Reading instructions for plugging and patching.	1. Industry study of tires. 2. Development of the pneumatic tire. 3. Trends in tire design.
		1. Tube manufacturing.
1. Cost of special purpose tires (racing).	1. Ability to read tire specifications.	1. Manufacture of special racing tires.
1. Cost difference between different styles of tires and tubes. 2. Profit computation. 3. Matching tire and tube sizes.	1. Prepare charts showing steps in dismounting and mounting a tire that can be posted near the tire changing equipment.	1. Changes in rim design. 2. Effect of new materials on tire design. 3. Discuss issue: No more tube type tires?
1. Different pressures for various sizes of tires. 2. Stopping distances of different tire designs: a. Regular tread. b. Snow tread. c. Studded tires. d. Chains.	1. Emphasizing safety to employees.	1. Safety in the service station and on the road. 2. Local regulations pertaining to studded tires.

III. APPLICATION

- A. Students should have experiences with tube patching, methods of tire patching, and valve stem repair.
- B. Students should also mount and dismount both tube and tubeless tires.
- C. Students may mount and dismount a large truck tire at the discretion of the instructor.

IV. EVALUATION CRITERIA GUIDELINE

- A. What are causes of air leakage in tires?
- B. What preventative maintenance should be carried out to preserve tube and tire life?
- C. What procedures for dismounting tires are different on trucks and buses?
- D. How does a mechanic know if his service has been performed correctly and satisfactorily?

V. SUMMARY

Tires and tubes may be repaired in a variety of ways. Caution should always be used when mounting and dismounting tires so as not to damage any materials. Large truck tires are always dangerous and should be handled carefully.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 60 minutes . . . Show films: **Tire performance, Care of Tires and Tire Construction.**
- 180 minutes . . . Lab experience with tires and wheels.
- 100 minutes . . . Related concepts in science, math, communications and social studies.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **Atlas Service Guide**, Volume I, New York: Humble Oil and Refining Company.
- 2) **Chassis Service Manual**, Detroit: Chevrolet Motor Division, General Motors Corporation, 1969.
- 3) Toboldt, William K. and Jarvis, Jud, **Motor Service's Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.
- 4) **Truck Shop Manual**, Detroit: Chevrolet Motor Division of General Motors Corporation, 1969.

INSTRUCTOR'S UNIT PLAN

Unit 20
Lesson 1
Time 6 hours

CLUSTER: TRANSPORTATION

DIVISION: AUTOMOTIVE SERVICES I

SUBJECT: **Wheel Alignment and Shock Absorber Service**

AIM: To provide a general understanding of automotive wheel alignment and shock absorption and begin to develop a specific level of skill in the use of alignment equipment.

INSTRUCTIONAL AIDS:

Charts - **Wheel Alignment Series**, Rock Island, Ill.: Bear Manufacturing Co.
Charts - **Mechanical Posters**, Pontiac, Mich.: Pontiac Motor Division (Available in sets only).

Slides - Teacher-made slide series on different steps in wheel alignment.

EQUIPMENT:

Slide projector and screen.

PRIMARY REFERENCES:

- 1) Allen, Willard A., **Know Your Car**, Chicago: American Technical Society, 1967, Second Edition.
- 2) Toboldt, William K., **Fix Your Chevrolet**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 3) **Wheel Alignment of Your Car . . . What It Is and How It Works**, Rock Island, Ill.: Bear Manufacturing Company (no date given).

I. INTRODUCTION and MOTIVATION

Show class a few discarded tires that show results of abnormal tire wear from improper wheel alignment. Have class try to determine what caused the wear and what should be done about it.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Wheel Alignment. Front end geometry.	1. Explain need for front end design to allow proper turning of car. 2. Stability of front end due to design. 3. Wheel alignment angles: a. Toe-in. b. Caster. c. Camber and steering axis inclination. d. Toe-out on turns.	1. Principles of leverage and mechanical action used in front end assembly. 2. Physical forces being exerted on front end assembly, i. e., gravity, momentum, friction and centrifugal force.
Toe-in.	1. Pointing inward of wheel fronts while car is still. 2. Why toe-in is necessary.	1. Effects of loose tie rod assembly and wheel bounce (caused by variations in road conditions) on toe-in settings.
Toe-out on turns.	1. Need for "inside" wheel to turn more sharply on turns. 2. Position of steering arms to facilitate toe-out on turns.	1. Effects of toe-in and toe-out on tire wear.
Camber and steering axis inclination.	1. Camber angle. 2. Relationship of camber and steering axis inclination.	1. Forces affecting camber. 2. Effects of weight concentration over wheels and its control. 3. Effects of engine location (front or rear) and camber settings.
Caster.	1. Purpose of caster and steering axis. 2. "Positive" and "negative" caster.	1. Differences in caster settings of solid front axle systems and independent suspension.
B. Shock Absorbers.	1. Effects of shock absorbers on car ride. 2. Effects of faulty shocks on tire wear and steering. 3. Service checks on shocks.	1. Shock absorber action. 2. Basic hydraulic principles.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Mathematical explanation of front end geometry. 2. Determination of angles and planes used on automotive front ends.	1. Be able to explain the various alignment angles to curious customers.	1. Early automotive front end design. Need for current assembly to allow car to turn on a radius. 2. Turning vehicles that do not use wheels (such as air cushion vehicles, boats, skis, etc.). 3. Concept of stability in autos, boats, planes and other vehicles.
1. Measure toe-in with proper gauge.		
1. Angular relationship between front wheels when turned to right or left. 2. Effects of wheel base and tread of an automobile on toe-out settings.	1. Read literature and instructions for using permanently installed wheel alignment equipment.	
1. Measuring camber and steering axis inclination angles.	1. Study historical development of front end geometry on other vehicles.	1. Basic design features of cars with independently suspended wheels such as Corvair and Volkswagen.
1. Measure caster angle.	1. Read and interpret charts showing various types of tire wear and causes. 2. Determine wheel alignment estimates of labor and parts from Flat Rate Manual.	1. Variations in high speed driving and wheel alignment settings. Alignment of racing cars.
1. Determine load factor for selecting shocks.	1. Advertising techniques used in selling shocks and other suspension components.	

III. APPLICATION

- A. Students should practice wheel alignment and service during the lab period to develop basic proficiencies.
- B. A study or review of front end geometry of other vehicles would enhance their understanding of the automobile. A visit to a historical museum may be considered.

IV. EVALUATION CRITERIA GUIDELINE

- A. What are the four major settings on automotive front end assemblies?
- B. What recommended procedures should be followed in alignment of front end?
- C. How much accuracy is needed in these front end measurements?
- D. What level of skill is necessary for proper use of alignment equipment?
- E. What is the function of shock absorbers?

V. SUMMARY

- A. Review purpose and need for front end assembly on automobiles. Point out safety factors related to front end geometry.
- B. Compare front axle and independent suspension systems.
- C. Discuss relationships of wheel alignment, wheel balance, tire rotation and shock absorbers.

VI. SUGGESTED TIME and SEQUENCE LISTING

- 45 minutes . . . Show teacher-made slides on wheel alignment.
- 15 minutes . . . Discuss importance of front end geometry.
- 180 minutes . . . Lab experiences with automobiles and alignment equipment
- 100 minutes . . . Discussion of related information in science, math, communications and social studies.
- 20 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

- 1) **How the Wheels Revolve**, Detroit, Mich.: General Motors Corporation.
- 2) **Mechanical Manual 1959-1967**, Volume 2, Berkeley, Calif.: National Automotive Service Company, 1967.
- 3) **Metallurgy and Wheels**, Detroit: General Motors Corporation.
- 4) **Motor's Auto Repair Manual**, New York: Motor Publishers, 1960 through 1970 Volumes.
- 5) Murphy, P., **Chilton's Automotive Repair Manual**, Phila.: Chilton Books, 1969.
- 6) Purvis, Jud, **Fix Your Volkswagen**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 7) Toboldt, William K., **Fix Your Ford**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1963.
- 8) Toboldt, William K. and Purvis, Jud, **Motor Service's Automotive Encyclopedia**, Homewood, Ill.: The Goodheart-Willcox Company, Inc., 1965.
- 9) Venk, Ernest A. and Billiet, Walter E., **Automotive Fundamentals**, Chicago: American Technical Society, 1961.

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- Automobile Story**, Detroit: General Motors Corporation.
- ***Automotive Air Conditioning Service Manual**, San Diego: National Automotive Service Co., 1968.
- Bachman, Frank P., **Great Inventors and Their Inventions**, New York: American Book Co., 1946.
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- Bostwick, Harold S., Green, Lawrence R. and Yergey, William H., **Auto-Mechanics Standard Practice Job Sheets . . . Part Two . . . The Fuel and Electrical Systems**, Milwaukee: Bruce Publishing Company, 1964.
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- Burns, William A., **Man and His Tools**, New York: McGraw-Hill Book Co., Inc.
- Christy, John, **How to Build Hot Rods and Race Them**, Indianapolis: Bobbs-Merrill Co., Inc., 1966.
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- ***Electricity and Wheels**, Detroit: General Motors Corporation.
- Elting, Mary, **Trucks At Work**, Irvington-on-Hudson, New York: Harvey House, 1962.
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- ***Fundamentals of Electricity and Magnetism**, DR-5133A, Anderson, Ind.: Delco-Remy Division of General Motors Corporation.
- Gault, William C., **Thunder Road**, New York: E. P. Dutton & Co., Inc., 1952.
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- Liberty, Gene, **The First Book of Tools**, New York: Franklin Watts, Inc., 1960.
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APPENDIX

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- Air Cooled News.** H. H. Franklin Club, P. O. Box 535, Cumberland, Md.
- American Rodding.** Popular Library, Inc., 355 Lexington Avenue, New York 10017.
- Atlas Bulletin.** Atlas Supply Company, 744 Broad Street, Newark, N. J.
- Auto Enthusiasts International Bulletin.** 886 Chippewa, Box 451, Mt. Clemens, Mich.
- Auto Sports.** 2430 W. Lawrence Avenue, Chicago, Ill. 60625.
- Auto Topics Magazine.** Floyd Clymer Publications, 222 N. Virgil Avenue, Los Angeles, Calif. 90004.
- Automobile Fact and Figures.** Automobile Manufacturers Association, 320 New Center Building, Detroit, Mich.
- Automobile Bulletin.** 800 S. Third Street, Louisville, Ky.
- Automobile Quarterly.** Automobile Quarterly, Inc., 245 W. Main Street, Kutztown, Pa. 19530.
- Automobile Topics.** Floyd Clymer Publications, 222 N. Virgil Avenue, Los Angeles, Calif. 90004.
- Automotive Cooling Journal.** National Automotive Radiator Service Association, 16929 Wyoming Avenue, Detroit, Mich. 48221.
- Automotive Data Book.** Frictional Materials Standards Institute, 370 Lexington Avenue, New York.
- Automotive Industries.** Chilton Company, Chestnut and 56th Streets, Philadelphia, Pa.
- Automotive Information.** Automobile Manufacturers Association, Inc., 320 New Center Building, Detroit, Mich.
- Automotive World.** Johnston International Publishing Company, 386 Park Avenue S., New York 10016.
- Autoproducts Magazine.** Cummins Publishing Company, Greenfield, Oak Park, Mich. 48237.
- Battery Man.** Independent Battery Manufacturers of America, 2939 Los Altos Drive, Largo Fla.
- Brake and Front End Service.** Babcox Publications, 11 S. Forge Street, Akron, Ohio.
- Car Craft Magazine.** Peterson Publishing, 5959 Hollywood Boulevard, Hollywood, Calif. 90028.
- Car and Driver.** Ziff-Davis Publishing, 1 Park Avenue, New York 10016.
- Car Life.** Bond Publishing Company, 834 Production Place, Newport Beach, Calif.
- Car Repair.** Davis Publishing, 505 Park Avenue, New York 10022.
- Cars.** Magnum/Royal Publishing, Inc., 185 Madison Avenue, New York 10016.
- Competition Press and Auto Week.** Competition Press, Inc., 15 Boardman Place, San Francisco, Calif.
- Custom Craft.** Jamie Publishing, Inc., 47 E. 44th Street, New York 10017.
- Custom Rodder.** Magnum Publishing, Inc., 26 W. 47th Street, New York 10036.
- Drag Racing.** Kintex Corporation, 3100 Riverside Drive, Los Angeles, Calif. 90027.
- Driveway Reporter.** (Service Station News), Automotive Trades Association, 196 Tache Avenue, St. Boniface 6, Manitoba, Canada.
- Exhaust.** Exhaust Publishing Company, 600 E. Washington Boulevard, Los Angeles, Calif.
- Ford News.** Ford Motor Company, Hardware & Accessories Plant, 2 Stewart Street, Dearborn, Mich.
- Garage and Service Station News.** 260 Raymur Avenue, Vancouver 6, B. C., Canada.
- Gasoline Retailer.** The Gasoline Retailer, Inc., 17 Union Square, New York.
- Hot Rod Magazine.** Petersen Publications, 5959 Hollywood Boulevard, Los Angeles, Calif. 90028.
- Humble Extra.** The Humble Oil and Refining Company, P. O. Box 2180, Houston, Texas 77001.

Independent Garageman, The. Independent Garagemen's Association of Texas, P. O. Box 9432, Austin, Texas.

Lamp, The. Standard Oil Company, 30 Rockefeller Plaza, New York, N. Y. 10020.

Modern Rd. Kintex Corporation, 3100 Riverside Drive, Los Angeles, Calif. 90027.

Modern Tire Dealer. Bill Brothers Publishing Company, Sheraton Hotel, Akron, Ohio.

Modern Tire Dealer Convention Extra. Bill Brothers Publishing, Sheraton Hotel, Akron, Ohio.

Modern Tire Dealer . . . Retread Week. Suite 434-439, Sheraton Hotel, Akron, Ohio.

Motor. Hearst Corporation, 250 W. 55th Street, New York 10019.

Motor Age. Chilton Company, Chestnut & 56th Street, Philadelphia, Pa.

Motor Trend. Petersen Publishing Company, 5959 Hollywood Boulevard, Los Angeles, Calif.

Motorcade. Coronado Book Corporation, 171 S. Barrington Place, Los Angeles, Calif.

Motorist. Erie County Motor Club, 111 W. 11th Street, Erie, Pa.

Muffler News. National Automotive Muffler Association, 1113 N. Myers, Burbank, Calif. 91506.

NPN (National Petroleum News: The Magazine of Oil Marketing). McGraw-Hill Book Company, Inc, New York, N. Y.

Popular Hot Rodding. Argus Publishers Corporation, 131 S. Barrington Place, Los Angeles, Calif.

Road Test. P. O. Box 33166, Los Angeles, Calif. 90033.

Road and Track. Bond Publishing Company, 834 Production Place, Newport Beach, Calif. 92663.

Rod & Custom. Petersen Publishing Company, 5959 Hollywood Boulevard, Los Angeles, Calif.

SAE Handbook. Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York, 10017.

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Service Station Management. Hunter Publishing, 205 W. Monroe Street, Chicago, Ill. 60606.

Service Station Management & Merchandising. Fullerton-Weston Publishing Limited, 93 Rainside Road, Don Mills, Ontario, Canada.

Service Station Selling. Bowes Seal Fast Corporation, 5902 E. 34th Street, Indianapolis, Ind.

Skid Marks. National Tire Dealers and Retreaders Association, 1343 L Street, N. W., Washington, D. C.

Sports Car. Sports Car Club of America, Inc., Box 791, Westport, Conn.

Sports Car Graphic. Petersen Publishing Company, 5959 Hollywood Boulevard, Hollywood, Calif.

Spring Specification Data Book. Spring Research Institute, 1008 Standard Building, Cleveland, Ohio.

Super Service Station. Irving-Cloud Publishing Company, 7300 N. Cicero Avenue, Lincolnwood, Chicago, Ill. 60646.

Tire Review Convention News. Babcox Business Publication, 11 S. Forge Street, Akron, Ohio.

Tire and Rim Association Standards Yearbook. 34 N. Hawkins Avenue, Akron, Ohio.

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Wheels. National Tire Dealers and Retreaders Association, 1343 L Street, N. W., Washington, D. C.